ELISHA HANSON

From a photograph by Robert F. Griggs

THE AWE-INSPIRING SPECTACLE OF THE VALLEY OF TEN THOUSAND SMOKES, DISCOVERED AND EXPLORED BY NATIONAL GEOGRAPHIC SOCIETY EXPEDITIONS

From the floor of this vast valley in Alaska several million jets of steam seethe and hiss—sibilant tongues telling the story of the hell's caldron of volcanic heat which lies beneath the surface. Over this thin crust of hot, treacherous earth, which often broke beneath their tread, Robert F. Griggs, leader of the Society's Expedition of 1917, and the members of his party made their way, back and forth, plunging through the suffocating vapors, trapping gases for chemical analysis, making soundings, mapping the course of the valley, and studying the geology of this most amazing example of her processes which Nature has revealed to twentieth-century man—one of Vulcan's melting-pots from which the world is created. Only about one-fifth of the valley is shown here; but it is difficult to get any real conception of the tremendous magnitude, even of this small portion, for it hardly seems credible that a distance of two miles separates the tent in the right foreground from the cloud of white steam immediately above it. The V-shaped crevasse in the central foreground, above which one of the members of the expedition is seen standing, was the natural stove used by the party in cooking all of their meals while encamped at the edge of this the First Wonder of the World.

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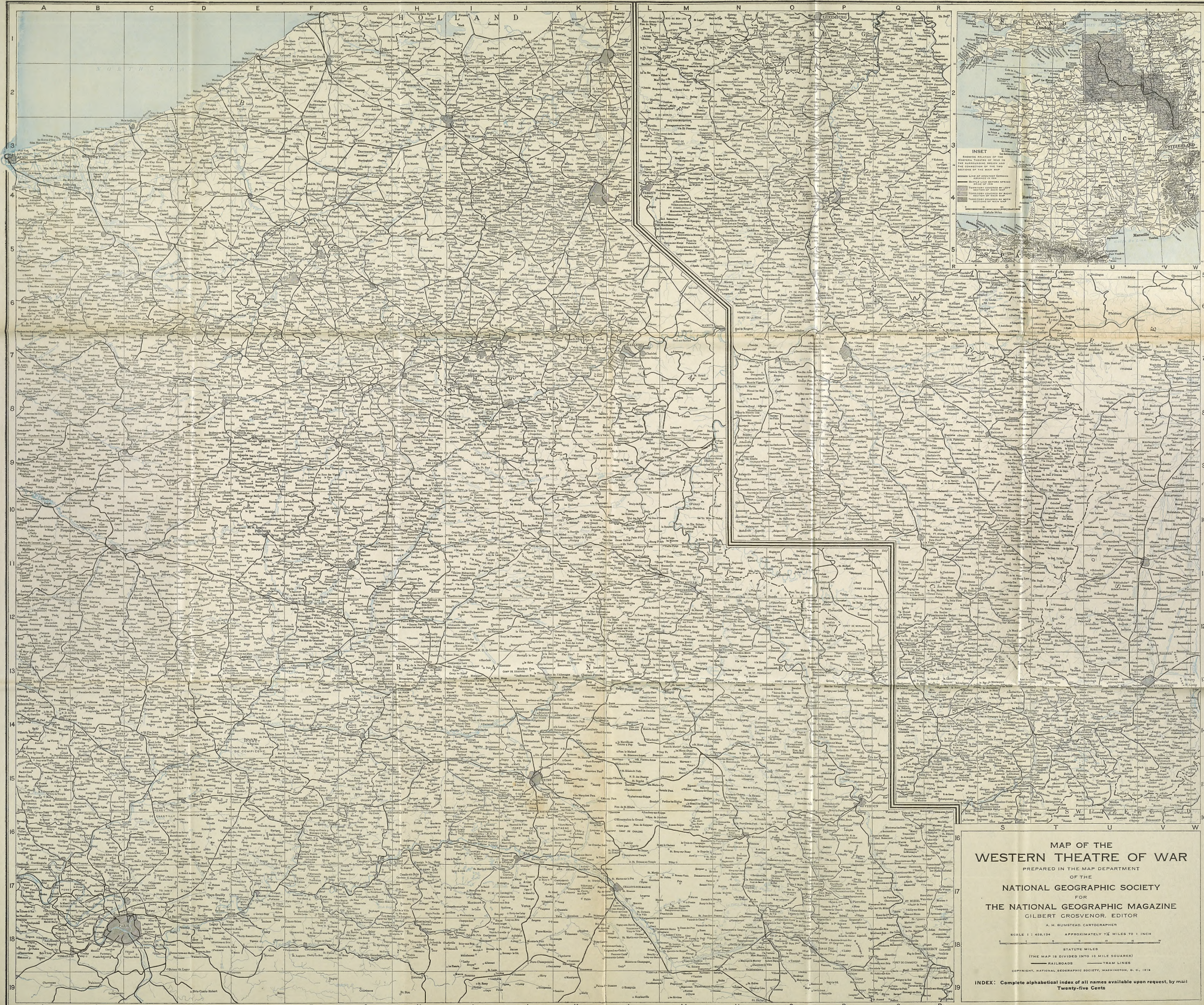

MAP OF THE WESTERN THEATRE OF WAR

PREPARED IN THE MAP DEPARTMENT
OF THE
NATIONAL GEOGRAPHIC SOCIETY
FOR
THE NATIONAL GEOGRAPHIC MAGAZINE
GILBERT GROSVENOR, EDITOR

A. H. BUMSTEAD, CARTOGRAPHER

SCALE 1 : 468,124 APPROXIMATELY 7¼ MILES TO 1 INCH

STATUTE MILES
(THE MAP IS DIVIDED INTO 10 MILE SQUARES)
RAILROADS TRAM LINES

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INDEX

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CONTENTS

	Page
Aces Among Aces. By Laurence La Tourette Driggs	568
Aces of the Air. By Capt. Jacques de Sieyes	5
America's Part in the Allies' Mastery of the Air. By Major Joseph Tulasne	1
Appeal to Members of the National Geographic Society, An	347
Battle-Ground of Nature, A: The Atlantic Seaboard. By John Oliver La Gorce	511
Billions of Barrels of Oil Locked up in Rocks. By Guy Elliott Mitchell	195
Building America's Air Army. By Lieut. Col. Hiram Bingham, Signal Corps, U. S. A.	48
Cooties and Courage. By Herbert Corey	495
Flying in France. By Capt. André de Berroeta, of the French Aviation Service	9
Forerunners of Famine. By Frederic C. Walcott, of the U. S. Food Administration	336
Forming New Fashions in Food: The Bearing of Taste on One of Our Great Food Economies, the Dried Vegetable, Which is Developing into a Big War Industry. By David Fairchild, Agricultural Explorer in Charge of Foreign Seed and Plant Introduction, U. S. Department of Agriculture	356
Future of the Airplane, The. By Rear Admiral Robert E. Peary, U. S. Navy	107
Gem of the Ocean, The: Our American Navy. By Josephus Daniels, Secretary of the Navy	313
Germany's Air Program	114
Germany's Dream of World Domination. By the Editor	559
Health and Morale of America's Citizen Army, The: Personal Observations of Conditions in Our Soldier Cities by a Former Commander-in-Chief of the United States Army and Navy. By William Howard Taft	219
Helping to Solve Our Allies' Food Problem: America Calls for a Million Young Soldiers of the Commissary to Volunteer for Service in 1918. By Ralph Graves	170
Hospital Heroes Convict the "Cootie"	510
Isle of Frankincense, The. By Charles K. Moser, Formerly United States Consul-General to Aden, Arabia	267
Italian Race, The. By the Editor	47
Italy's Eagles of Combat and Defense: Heroic Achievements of Aviators Above the Adriatic, the Apennines, and the Alps. By Kindness of Gen. P. Tozzi, Chief of the Italian Military Mission	38
Life Story of an American Airman in France, The: Extracts from the Letters of Stuart Walcott, Who, Between July and December, 1917, Learned to Fly in French Schools of Aviation, Won Fame at the Front, and Fell Near Saint Souplet	86
National Geographic Society	170
National Geographic Society in War Time, The. By Major-General A. W. Greely, U. S. Army	369
Plain Tales from the Trenches: As Told Over the Tea Table in Blighty—A Soldiers' "Home" in Paris. By Carol K. Corey	300
Prussianism. By Robert Lansing, Secretary of State	546
Shopping Abroad for Our Army in France. By Herbert Corey	206

PAGE

Smaller Mammals of North America. By EDWARD W. NELSON, Chief, U. S. Biological Survey 371*

Symbol of Service to Mankind, The: The Greatest Humanitarian Movement of Modern Times Originated in a Practical Attempt to Meet a Practical Need with a Practical Remedy. By STOCKTON AXSON, National Secretary, American Red Cross..... 375

Tales of the British Air Service. By Major WILLIAM A. BISHOP, V. C., D. S. O., M. C. 27

Unique Republic, Where Smuggling Is An Industry, A. By HERBERT COREY..... 279

Valley of Ten Thousand Smokes, The: An Account of the Discovery and Exploration of the Most Wonderful Volcanic Region in the World. By ROBERT F. GRIGGS, Director of the National Geographic Society Katmai Expeditions of 1915, 1916, and 1917 115

Voyaging on the Volga Amid War and Revolution: War-time Sketches on Russia's Great Waterway. By WILLIAM T. ELLIS..... 245

What Is It To Be An American? By FRANKLIN K. LANE, Secretary of the Interior.. 348

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INDEX FOR VOLUME XXXIII (JANUARY-JUNE), 1918

AN ALPHABETICALLY ARRANGED INDEX — ENTRIES IN CAPITALS REFER TO ARTICLES

"A"

Page

Abert squirrel..... ill. (colored), 448; text, 462
Abyss of inconceivable size: Katmai volcano.... 162
Accidents in the world of discovery, Few..... 325
Ace, Great Britain's premier: Major Bishop. ill., 571; text, 572
ACES AMONG ACES. BY LAURENCE LA TOURETTE DRIGGS 568
Aces Among Aces..... ill., 569-573, 576, 577
ACES OF THE AIR. BY CAPTAIN JACQUES DE SIEYES, OF THE FRENCH AVIATION SERVICE 5
Aces, Roll of: All belligerents..... 575
Adage, Ancient: "Whom the gods destroy they first make mad"..... 387
Aden, Arabia: Arabian kitchen, ill..... 272
Administrative personnel must be trained: Air army 77
Adriatic, Heroic achievements of aviators above the Apennines, the Alps, and the..... 38
Adriatic, The flight across the: Italian airmen.. 41
Aërial mail service outlined..... 110
Aërial photographs, Interpretation of..... 15
Aëro Club of America, Transcontinental airways proposed by the..... 113
Aërograph: Alton Beach, Florida, ill..... 67
Aëronaut, French: In observation balloon, ill... 17
Aëronautical training station, American, ill..... 83
Africa, portion wanted by Germany..... 559
Age of "reformatory" authors: England..... 376
Agriculture: Farm scene, ill..... 564
Agriculture: Harvesting the grain, France, ill.... 368
Agriculture, How the dried vegetable habit would change world 361
Agriculture: Pig raising, ill..... 172-182, 184-191
Aiding the Government in training flyers..... 110
Air, Aces of the. By Captain Jacques de Sieyes 5
Air admirals of the future..... 107
Air anchors: Kite balloon, ill..... 85
Air Army, Building America's. By Lieut. Col. Hiram Bingham 48
Air fleet, Arrival of America's anxiously awaited. 1
Air fleets of the sea: Nature's warfare..... 511
Airman giving a "password" shot, ill..... 34
Airman in France, Life story of an American.... 86
Airplane: Atlantic coast, ill..... 520
Airplane, British: Holy Land, ill..... 29
Airplane engine, Life of: 100 hours..... 61
Airplane, Hydro, ill..... 324
Airplanes and aces, ill.... 569-573, 576, 577, 579, 580
Airplanes, Austrian, ill..... 39, 45
Airplanes, British, ill..... 29, 30, 31, 36, 37
Airplanes for America's air army, ill..... 48-69, 88, 90, 97, 100
Airplanes, German, ill..... 38, 99
Airplanes in the making: United States, ill.... 48-62
Airplanes, Italian, ill..... 39, 41-44, 46
Airplanes, Scenes taken from, ill.... 2, 8, 10, 11, 17, 18, 26, 28, 34, 37, 67-69, 100, 102
Airplanes: Sham battle in the sky, ill..... 100
Airplane, Submarine secondary to..... 109
Airplanes which are used at night only..... text, 26; ill., 579
Airplane, The Future of the. By Rear Admiral Robert E. Peary, U. S. Navy..... 107
Airplane wing, Manufacture of, ill..... 54, 55
Airplane with folding wings, ill..... 31
Air Program, Germany's..... 114
Air raid, British children in a cellar during an, ill. 374
Air raids, Shattering the enemy's morale by..... 3
Air service development..... 13
Air Service, Tales of the British. By Major William A. Bishop, V. C., D. S. O., M. C..... 27
Air triumphs, One of America's..... 51

Page

Airways, Four trancontinental..... 113
Alaska: The Valley of Ten Thousand Smokes. By Robert F. Griggs..... 115
Alcohol, Potatoes raised for: Germany..... 205
"All foreign influence in middle Europe must be eliminated": Prussianism 563
Alliances, Animal: Defensive and offensive..... 383*
Allied Aces, Task of the..... 580
Allies' flour barrel: Chart showing supply and demand, ill. 344
Allies' Mastery of the Air, America's Part in the. By Major Joseph Tulasne..... 1
Alps, Airplanes above the, ill..... 39
Alps, Heroic achievements of aviators above the Adriatic, the Apennines, and the..... 38
Alsace memorial: Strassburg monument, ill..... 304
Alton Beach, Fla.: An aërograph, ill..... 67
Ambition to be "supermen," An: Prussianism... 549
Ambrose Channel Lightship..... 541
America, A new spirit in..... 354
America, French aviation mission to, ill..... 4
American Aces, Record of..... 577
American airman in France, Life story of an.... 86
American airplanes in France will hasten end of war 3
American Ambulance Hospital: Paris, ill..... 370
American aviator: Stuart Walcott, ill..... 105
American battleships in column formation, ill. 323, 331a
American battleship welcomed by French aviator, ill. 6
American companies drying vegetables and fruits. 367
American Expeditionary Forces, ill..... 496, 498-500, 502-504, 506, 508
American flying schools: Airplanes, ill. 88, 90, 97, 100
"American labor, Why not import": France..... 218
American Mammals, The Smaller North. By E. W. Nelson 371*
American marmot, or common woodchuck.. text, 431; ill. (colored), 432
American marmot: Tracks, ill..... 475
American mink.....ill. (colored), 453; text, 472
American mink; Tracks, ill..... 482, 483
American Navy, Our: The Gem of the Ocean. By Josephus Daniels 313
American officer in France, Type of..... 497
American oil-shale industry will far outstrip Scotland 202
American "outfit" enters a town, When an..... 495
American railway station in France, ill..... 212
American Red Cross abroad, ill.. 339b, 346, 373, 377, 378, 380-382, 384, 387
American Red Cross and its functions..... 387, 388
American sable, or marten..... ill. (colored), 453; text, 473
American's habitudes are changing..... 360
American shales enormous, Quantity of oil in.... 197
"Americanski" liked by the Russians..... 255
Americans of native lineage have a great duty... 348
American soldiers, French women to can for..... 216
American submarine submerging, ill..... 324c
American, What is it to be an. By Franklin K. Lane 348
America rich in aviator man-and-woman power.. 109
America's Air Army, Building. By Lieut. Col. Hiram Bingham 48
America's air triumphs, One of..... 51
America's appeal to patriots, ill..... 550
America's Citizen Army, The Health and Morale of. By William Howard Taft..... 219
America's lumber resources, Straining..... 53
AMERICA'S PART IN THE ALLIES' MASTERY OF THE AIR. BY MAJOR JOSEPH TULASNE, CHIEF OF THE FRENCH AVIATION MISSION TO AMERICA..... 1
America, The real story of..... 351

Page

"America will be the friend of all the world"... 294
Analogy of fresh vegetables and fresh cereals... 358
An amazing instance of bad faith in Germany... 553
Anatomy of a machine-gun, Studying the, ill.... 74
Anchors, Air: Kite balloon, ill..... 85
Anchors, Ship's, ill..... 331
Ancient source of frankincense: Socotra..... 267
Andorra la Vieille, Andorra Republic, ill... 291, 296
Andorra Republic: Scenes, ill..... 282-286, 288, 296
Andorra Republic, Where Smuggling is an Industry. By Herbert Corey..... 279
Andre, Lieutenant: French ace, ill..... 572
Animal chemists change starch into water..... 374*
Animal intelligence akin to man's..... 380*
Animals: Cows and calves, ill..... 564
Animals: Smaller North American Mammals. By E. W. Nelson..... 371*
Animals that have to sing..... 381*
Animals that put themselves in cold storage..... 382*
Animals that seek safety in darkness..... 378*
Antagonistic species, Ebb and flow of: Animals.. 377*
Ant-bear: Mascot of the Marines, War Zone, ill. 504
Antelope chipmunk..... ill. (colored), 437; text, 443
Antelope jack rabbit... text, 384*; ill. (colored), 404
"An unstable peace would be a curse": World war..... 547
Apennines, Heroic achievements of aviators above the Adriatic, the Alps, and the..... 38
Appeal to members of the National Geographic Society..... 347
Appreciation, An: The Italian Race. By the Editor..... 47
Appropriation for National Geographic Society's fifth expedition to Alaska..... 372
Arab and donkey near a British airplane, ill..... 29
Arab chiefs: Socotra, ill..... 274
Arabian kitchen: Aden, Arabia, ill..... 272
Arches, Eiffel tower: Paris, France, ill..... 307
Arctic hare..... text, 389*; ill. (colored), 408
Area of the German Empire before the war..... 559
Arizona, U. S. S.: At sea, ill..... 321
Armadillo, Nine-banded.. ill. (colored), 457; text, 480
Arm badge, Red Cross: Adopted in Geneva, 1864 386
Armed neutrality: Dog and skunk, ill..... 377*
Armenia: Charts showing deaths by fighting and famine, ill..... 337
Armenians of the Volga region, Russia, ill..... 255
Armies have more to live and die for than ever before..... 354
Army: Andorra Republic..... 299
Army aviator's uniform, U. S., ill..... 93, 105
Army in France, Shopping Abroad for Our. By Herbert Corey..... 206
Army of 5,000,000 needed..... 244
Army, Raw material for a matchless: Russia.... 248
Army's business operations figured in tonnage... ill., 208; text, 215
Army supplies, U. S., ill..... 207, 208, 212, 215, 217
Army, The Health and Morale of America's Citizen. By William Howard Taft..... 219
Art gallery, Paris: Trocadero, ill..... 307
Articulating the skeleton of an airplane's fuselage, ill..... 56
Artillerists appealed to aviators..... 15
Artillery (Field) in training, Chickamauga, ill... 224
Art in town crying, An..... 293
Ascent of Katmai, The..... 162
Asian aspirations of Germany..... 559
Ash-covered snow-drift, Katmai, Alaska, ill.. 124, 158
Aspirations in North America, Germany's 561
Assateague Island, Va.: Map, ill..... 534
Astrakhan, Russia: Volga port.... ill., 247; text, 262
"As we will it!": Prussian doctrine..... 549
Atlantic fleet, Champion racing crew of the, ill... 229
Atlantic seaboard, ill...512, 514-516, 518-520, 52 526, 528-537, 540, 54 544
Atlantic Seaboard, A Battle-Ground of Nature. By John Oliver La Gorce..... 511
Attack, Various modes of: Airplanes..... 19
Attacking the enemy's most vulnerable position.. 24
Auger, Alfred: French ace, ill..... 572
Augusta, Ga.: Camp Hancock, ill..... 225, 241
Australia: Pig family, ill..... 185
Australians' dinner party: Soldiers at Blighty... 303
Australia wanted by Germany..... 559
Austria-Hungary: Charts showing deaths by fighting and famine, ill..... 337
Austrian airplane brought down: Italian front, ill. 45
Austrian Albatross: Italian front, ill..... 39
Austrian and German aces, Record of..... 578, 579

Page

Authors, Reformatory: England..... 376
Automobile speedway, Ormond-Daytona, Fla., ill. 528
Aviation cadets in training..... 83, 85
Aviation Mission to America, French, ill..... 4
Aviation schools: United States, ill.... 63-65, 70-79, 88, 90, 94, 97, 100, 234
Aviation, Three branches of..... 11
Aviator, French, welcomes American battleship, ill..... 6
Aviator man-and-woman power, America rich in. 109
Aviators, ill..... 4, 105, 324, 569-573, 576, 577
Aviators: Aces among aces. By Laurence La Tourette Driggs..... 568
Aviator's sign-post for night flying, ill..... 112
Aviator's tests, Prospective..... ill., 70-73; text, 82
Aviator's uniform, U. S. Army, ill..... 93, 105
Aviatrix, American: Ruth Law, ill..... 111
Axson, Stockton, National Secretary, American Red Cross: The Symbol of Service to Mankind 375

"B"

Baby kissing soldier father good-bye, ill..... 552
Bailo, Captain: Italian airman..... 45
Bakery, Field: National Guard camp, ill..... 227
Balance test: Aviation..... 82
Ball, Albert, Some of the exploits of: Royal Flying Corps..... 27, 573
Balloon before its inflation with hydrogen gas, ill..... 80
Balloonist's life-boat: The parachute, ill..... 32
Balloonists, Twin service of: Air army..... 80
Balloons, Destroying German kite..... 21
Balloons in war, ill..... 17, 22, 24, 25, 32, 35, 80-85
Banded lemming..... text, 401; ill. (colored), 417
Band, Sailors', in W. S. S. Campaign: New York City, ill..... 389
Bankers finance pig-club boys.....text, 174; ill., 178
Baracca, Major: Italian airman..... 47
Barbieri, Squadron Commander: Italian air fleet. 45
Barcelona, Spain: Daily life..... 279
Barn painting as guide to aviators, ill..... 112
Barometer, Food resources: Supply and demand, ill..... 341
Barrel, Allies' flour: Chart showing supply and demand, ill..... 344
Basket of an observation balloon, ill..... 17
Bat, Big-eared desert....ill. (colored), 465; text, 492
Bathing an ordeal in northern France..... 504, 506
Bathing suits are unappreciated, Where: Russian peasants..... 261
Bat, Hoary.....text, 491
Bath, Story of a: Soldier at Blighty..... 309
Bat, Mexican.....ill. (colored), 465; text, 491
Bat, Red.....ill. (colored), 464; text, 489
Bats with bulldog faces..... 382*
"Battalions of Death": Russian women soldiers. 251
Batteries, Fake, to deceive scout planes..... 15
BATTLE-GROUND OF NATURE, A: THE ATLANTIC SEABOARD. BY JOHN OLIVER LA GORCE..... 511
Battle in the sky, Sham: Airplanes, ill..... 100
Battlements of the Maine coast..... 513
Battleship, American: In foreign waters, ill..... 6
Battleship at anchor in home waters, ill..... 84
Battleship, British: H. M. S. *Canning*, ill..... 35
Battleships, Italian: In the harbor, ill..... 43
Battleships, United States, ill..... 315*a*, 315*b*, 317*a*-321, 321*b*, 323, 324*d*, 325*b*, 327*a*, 329-331*a*, 333, 389
Battleship with a naval hydro-airplane on the deck, ill..... 108
Battle's progress sent by radio..... 16
Battle, World's greatest..... 354
Bayonet drill, Sailors practicing, ill..... 321*a*
Bayonet practice by U. S Marines in France, ill. 242
Beach mouse.....text, 422; ill. (colored), 428
Beach scene: Ormond-Daytona, Fla., ill..... 528
Beacons that guard the neutral's rights: Nature's warfare..... 538
Bear tracks, Katmai Valley, Alaska.....text, 129; ill., 152
Bear trail that sprouted, Katmai Valley, Alaska, ill..... 152
Beasts that roam the night, Countless..... 379*
Beauchamp, Captain de..... 7
Beauregard, General: Suggested neutrality of army surgeons in war..... 386

Page

Beaver, Mountain.....text, 427; ill. (colored), 432
Bedouin cave-dwellers, Among the: Socotra..... 273
Beef: Barometer of supply and demand, ill..... 341
Beet, Sugar: Area in America..... 361
Beggar at Nizhni Novgorod, Russia, ill..... 250
Belgian aces, Record of..... 578
Belgium, All that was left of..... 214
Belgium, A matter of German "Honor" to hold. 565
Belgium: Chart showing deaths by fighting and famine, ill..... 337
Belgium in Nature's warfare, A: wrecked ship, ill..... 512
Belgrade, Serbian children of tragedy at, ill.... 339*b*
Bell, Alexander Graham: American inventor.... 113
Bell and Chanute airway, The proposed..... 113
Belligerents, Roll of aces of all..... 575
Benefits from boys' and girls' clubs..... 183
Benois, Lieutenant: French airman, ill..... 573
Berlin, Deceived by military clique of: Prussianism 554
Bernhardi, General von: Quotations..... 563
Big-eared desert bat.....ill. (colored), 465; text, 492
Big-eared rock mouse....text, 423; ill. (colored), 429
Billeting officers precede an "outfit"..... 495
BILLIONS OF BARRELS OF OIL LOCKED UP IN ROCKS. BY GUY ELLIOTT MITCHELL, OF THE UNITED STATES GEOLOGICAL SURVEY..... 195
Bingham, Hiram, Lieut. Col., Signal Corps, U. S. A., Chief of the Air Personnel Division in the Office of the Chief Signal Officer of the Army: Building America's Air Army..... 48
Biplane, Caproni, flying near the Woolworth tower, New York City, ill..... 46
Biplane looping-the-loop, Newport News, Va., ill. 68
Biscayne Bay, Fla.: Aviation school machine, ill..... 63, 67
Bishop, William A.: Royal Flying Corps ace..ill., 33, 571; text, 572
Bishop, William A., Major, V. C., D. S. O., M. C.: Tales of the British Air Service..... 27
Black bread: Russia..... 248
Black cross of defeat, ill..... 45, 99
Black-footed ferret.....ill. (colored), 449; text, 469
Blarina, or short-tailed shrew: Tracks, ill..... 490
Bleriot training, Advantages of the: Aviation... 91
Bley, Fritz: Quotation..... 563
Blighty—A soldiers' "home" in Paris.....text, 300; ill., 302
Blood of the brave not shed in vain..... 547
Blossoms and fruit, Frankincense: Socotra, ill., 269, 270
Blount, Henry Fitch: Resolution concerning his death 371
Bluejackets forming a living flag, ill..... 228
Bluejackets, United States, ill..... 314, 315, 315*b*, 316, 320, 321*a-b*, 324*a*, 325*a*, 326, 327*a*-329, 329*b*, 330, 331*b*, 334, 389
Blue mud, Katmai Valley, Alaska..... 139
Blue smoke, Katmai Valley, Alaska..... 137
Blunderbuss made by Tower, in London: Andorra 299
Boar's tusks, Prussian, must be drawn..... 388
Boat-house and lagoon: Great Lakes Training Station, ill..... 64
Boat life on the Volga, Russia.....text, 245; ill., 256, 258, 259
Boats, Seine River: Paris, France, ill..... 308
Boats, Socotran, ill..... 275
Boats, Torpedo-: Marking the way for Italian airmen 41
Bolshevik idea of freedom..... 248
Bombardment, Aviation of..... 11
Bombing machine, Handley-Page, ill..... 36
Boreas' court, New coats for..... 381*
Boston bull, "Buster": Mascot of the *Texas*, ill.. 324*a*
Bothe, Lieutenant: German aviator..... 114
Bottle-fed pig, ill..... 173
"Boulder Flow, Great Mageik": Alaska.....ill., 159, text, 161
Boundary lines of European nations as drawn by hunger, ill..... 338
Bowles, Charles S. P.: Geneva Conference.. 385, 386
Boy riding a pig, ill..... 174
Boys diving for coins: Socotra.....text, 268; ill., 277
Boys' pig clubs.....text, 170; ill., 172-175, 177-182
Boy's plea for more hogs, A..... 187
Bread, Black: Russia..... 248

Page

Bread: Field bakery, National Guard Camp, ill.. 227
Bridge and canyon of Sant Antoni, Andorra, ill. 288
British aces, Records of the..... 577
British airman giving a "pass-word" shot, ill.... 34
British airplanes, ill..... 29-31, 36, 37
British Air Service, Tales of the. By Major William A. Bishop, V. C., D. S. O., M. C..... 27
British army, Dried vegetables for the, ill..... 366
British children in a cellar during an air raid, ill. 374
British fight the cootie, How the..... 506
British observer landing in a tree, ill..... 32
Broadside, Firing a: U. S. S. *New Hampshire*, ill. 317*a*
Brown lemming.....text, 402; ill. (colored), 417
Brown rat.....text, 423; ill. (colored), 429
Brown rat: Tracks, ill..... 472
Brown, Roy: Canadian ace..... 575
BUILDING AMERICA'S AIR ARMY. BY LIEUT. COL. HIRAM BINGHAM, SIGNAL CORPS, U. S. A., CHIEF OF THE AIR PERSONNEL DIVISION IN THE OFFICE OF THE CHIEF SIGNAL OFFICER OF THE ARMY..... 48
Buildings of greater New York would not fill Katmai crater..... 169
Building, tallest in the New World: Woolworth tower, New York City, ill..... 46
Bulgaria: Charts showing deaths by fighting and famine, ill..... 337
Bulldog "Buster," mascot of the *Texas*, ill..... 324*a*
Bulldog faces, Bats with..... 382*
Burden of profiteering falls upon the wage-earner 343
Burgess, Abbie, and the Matinicus light..... 539
"Buster," Boston bull, mascot of the new *Texas*, ill. 324*a*
"Butte" in the Valley of Ten Thousand Smokes, ill. 148
By-products of naval activities..... 316
Byzantine Church of Santa Coloma: Andorra Republic, ill..... 285

"C"

Cab driver: Nizhni Novgorod, Russia, ill..... 251
Caddo Parish, La.: Original boys' pig club..... 171
California ground squirrel.....ill. (colored), 437; text, 439
California jack rabbit...text, 385*; ill. (colored), 405
Camel machines in flight over a British aërodrome, ill..... 31
Camouflage, ill..... 224
Camouflage of the sea: Smoke screen, ill.. 324*b*, 327*a*
Campobello Island: British ground..... 513
Camp Hancock: Soldiers in training, ill..... 225, 241
Camp: Katmai expedition to Alaska, 1917, ill... 116, 160, 164, 165
Camps, Cost of: U. S. cantonments..... 239
Camp, U. S. Geological Survey: Wash day, ill.. 202
Canada: Pumpkin field, ill..... 193
Canada: Vegetable-drying factory, ill. 363*a*, 363*b*, 366
Canadian Companies drying vegetables and fruits. 368
Canillo, Andorra Republic, ill..... 286
Canned goods for the American soldiers in France, ill..... 207
Canning at home must not be discouraged..... 364
Canning, H. M. S., and its kite balloon, ill..... 35
Cannon, Column of: Place Vendôme, Paris, ill.. 310
Canteens, Red Cross, ill..... 377, 378, 380, 381, 384
Canton, China: Pigs going to market, ill..... 191
Cantonments, Cost of the..... 238
Canyon of Sant Antoni, Andorra, ill..... 288
Cape Ann, Mass.: Rocky Coast..... 521
Cape Elizabeth, Maine: Portland Head Light, ill. 523
Cape Hatteras light..... 541
Cape Henry, Va.: Coast scene, ill..... 536
Cape Henry, Va.: Lighthouses, ill..... 516
Caproni biplane flying near the Woolworth tower, New York City, ill..... 46
Caproni bombing machines: Italy..... 40
Caravan along the Wadi Motaha, Socotra, ill.... 266
Career of Captain von Richthofen: German ace. 574
Carrier's cart: Ripoll, Spain, ill..... 287
Cart, Horse, Spain, ill..... 287
Cart immortalized by Don Quixote..... 280
Carts, Spanish, ill..... 287, 290, 294, 295
Castor-oil bean-raising industry reëstablished: United States..... 48

Page

Castor-oil beans for American airplanes..... 48
Catalan dance, National: Andorra, ill..... 296
Cat and squirrel: Hereditary enemies, ill..... 372*
Cat, Common: Tracks, ill..... 385*
Caterpillar stage, An airplane in the, ill..... 60
Cathedral, "Cross of Chartres": An airman's view, ill..... 2
Cat, Ring-tailed.....ill. (colored), 460; text, 482
Cats and dogs as pets, Pigs rival..... 181
Cattaro, Austrian naval base bombed by Italian airmen..... 45
Cattle on a farm, ill..... 564
Cattle, Socotran..... 271
Caught in dangerous cross-currents: Italian airmen..... 40
Cave-dwellers, Among the Bedouin: Socotra..... 273
Cave-ins and fumes feared: Katmai district, Alaska..... 121
Caviar, World's source of supply of: Volga, Russia..... 247
Cellar, Children in bomb-proof: British Isles, ill. 374
Central thought of Prussianism..... 547
Cerberus, Mount: Katmai Valley, Alaska..text, 130; ill., 130, 140
Chalk-line, Walking a: Aviation test, ill..... 71
Champion pig raised by a boy of six.....text, 176; ill., 179
Champion racing crew of the Atlantic fleet, ill.. 229
Chanute, Octave: Pioneer aëronautic engineer.. 113
Chart: Illiterates in United States, showing increase and decrease, ill..... 350
Charts, Food: Showing supply and demand, ill. 341, 344
Charts showing deaths by fighting and famine, ill. 337
Chemical laboratory in the Katmai region, Alaska, ill..... 165
Chemical manufacturing plant, Like a huge: Valley of Ten Thousand Smokes..... 151
Chicago to New York via airplane: Ruth Law, ill. 111
Chickamauga, First Virginia Field Artillery in training at, ill..... 224
Chickens and pigs travel with the family: Volga steamer..... 259
Children: Andorra Republic, ill..... 283
Children, Armenian: Russia, ill..... 255
Children in cellar during an air raid: British Isles, ill..... 374
Children, Italian refugee: Drinking soup, ill..... 346
Children, Serbian refugee, ill..... 339*b*
China, Canton: Pigs going to market, ill..... 191
China, Conquest of: Germany's dream..... 567
Chipmunk, Antelope....ill. (colored), 437; text, 443
Chipmunk, Eastern.....ill. (colored), 440; text, 447
Chipmunk, Eastern: Tracks, ill..... 477
Chipmunk, Golden.....ill. (colored), 440; text, 443
Chipmunk, Oregon.....ill. (colored), 441; text, 450
Chipmunk, Painted.....ill. (colored), 441; text, 451
Church, Byzantine: Andorra Republic, ill..... 285
Church, D. B., Photographer, Katmai Expedition, 1917: Testimony..... 153
Cigognes ("Storks"), Fonck of the..... 568
Civilian Relief, Red Cross Department of..... 388
Civilization, Socotra's early..... 276
Clouds, Out of the storm: Airplane, ill..... 69
Coastal airship landing in a gale, British, ill.... 37
Coast-guard crew, ill..... 540
Coast-guard cutters, Work of the..... 545
Coat of arms and motto: Andorra Republic, ill.. 284
"Coddlers": Trench pests..... 497
Coffee, Roasting Mocha: Arabia, ill..... 272
Coins, Diving for: Socotra.....text, 268; ill., 277
Cold storage, Animals that put themselves in.... 382*
Colonne Vendôme: Paris, France, ill..... 310
Colorado, A mountain country resembling: Spain 281
Color and geography: Animals..... 374*
Color-sense tester, Jennings self-recording..... 82
Combat and Defense, Italy's Eagles of. By General P. Tozzi..... 38
Combat, Aviation of..... 11
Combat in the air, A mimic..... 104
Communiques of Nature's warfare..... 521
Community driers for vegetables and fruits..... 368
Community wash-houses: France..... 505
Conceptions of the American Red Cross, Two main..... 388
Confession, A sinister German..... 549
Confession, Herr Thysson's amazing..... 561
Conquerors, Kaiser's worship of ruthless..... 561

Page

Conquest of India and China with Turkey's aid: Prussianism..... 567
Conspirators, Watch long kept on German..... 553
Convalescent ward: U. S. Military Hospital No. 1, Paris, ill..... 371, 372
Convulsion of nature: Katmai Valley, Alaska... 161
Cony, Little chief hare, or pika.....text, 392; ill. (colored), 409
Cooking at a fumarole: Katmai district, Alaska.. ill., 120, 122, 150; text, 123
Cooking fish on the hook, Possibility of: Katmai Valley, Alaska.....text, 141; ill., 141
Cooking of dried vegetables requires care..... 367
Cook roasting Mocha coffee: Arabia, ill..... 272
Cootie is a hardy insect..... 505
Cootie pest, Eliminating the, ill... 496, 498, 500, 503
COOTIES AND COURAGE. BY HERBERT COREY..... 495
Cootie started, How the..... 507
"Cooties": Trench pests..... 497
Corey, Carol K.: Plain Tales from the Trenches. 300
Corey, Herbert: A Unique Republic, Where Smuggling is an Industry (Andorra Republic). 279
Corey, Herbert. Cooties and Courage..... 495
Corey, Herbert. Shopping Abroad for Our Army in France..... 206
Corn and hog ratio is 13 to 1..... 343
Corn: Barometer of supply and demand, ill..... 341
Corner in correspondence: Camp post-office, ill... 226
"A Corner in Pigs": Market in St. Brieuc, France, ill..... 187
Corn, Harvesting, ill..... 194
Costumes: Russian peasants..... 261
Costumes, Spanish..... 295
Cottontail rabbits.....text, 390*; ill. (colored), 408
Cottontail rabbit: Tracks, ill..... 390*
Counterfeits rubles, Germany..... 342
Courage, Cooties and. By Herbert Corey..... 495
Cow and calves, ill..... 564
Cranes used in unloading ships, Steam: France, ill..... 217
Crater dimensions, Katmai volcano..... 167
Crater, Greatest active, in the world: Katmai... 168
Crater Lake, Oregon: Dimensions..... 168
Craters of the plain, Katmai Valley, Alaska..... 134
Crimea, What Florence Nightingale accomplished in the..... 381
Cross-country flight, The first: Stuart Walcott... 93
Cross-currents, Caught in dangerous: Italian airmen..... 40
Crosses, Wooden: "The Dead Arisen," ill..... 355*b*
"Cross of Chartres" Cathedral, Airman's view of, ill..... 2
Cross of Defeat, Black, ill..... 45, 99
Crusade, A mighty: World war..... 557
Crying, An art in town..... 293
Cucumber tree: Socotra..... 273
Czechs desert to Liberty's armies..text, 253; ill., 264

"D"

Dahamis, Socotra..... 273
Dance, National Catalan: Andorra Republic, ill.. 296
Dangerous and contagious doctrine..... 336
Daniels, Josephus, Secretary of the Navy. The Gem of the Ocean: Our American Navy..... 313
Darkest page in human history..... 338
Day-and-night race, A: New air industry..... 56
Days and nights in the trenches..... 503
Days when profiteers will be dead..... 324
Daytona-Ormond Beach, Fla., ill..... 528
"Dead Arisen, The": French drawing, ill..... 355*b*
Deaths by fighting and famine, Charts showing: World war, ill..... 337
Debeque, Colorado, Experimental oil still, ill.... 201
De Berroeta, André, Captain of the French Aviation Service: Flying in France..... 9
Deck scenes on a Volga steamer..... text, 257, 259; ill., 256, 258, 259
Decorations are bestowed, When: Aviation..... 103
Deermouse: Tracks, ill..... 470
Defense, Italy's Eagles of Combat and. By Gen. P. Tozzi..... 38
Defensive and offensive animal alliances..... 383*
Dehn, Paul: Quotation..... 563
Delousing establishment: At the front..... 508
"Delousing fund": Germany..... 507
Delousing machine for killing cooties: War zone, ill..... 496, 500, 503

Page

Dente del Pasubio, Airplanes above the: Italian front, ill 39
Deposits all colors of the rainbow, Katmai Valley, Alaska 139
Derrick hoisting an enemy airplane, ill..... 38
Deserted city: Nizhni Novgorod, Russia..... 246
De Sieyes, Jacques, Captain of the French Aviation Service: Aces of the Air..... 5
Destroyer named for chief gunner's mate..... 321*b*
Destroyers, United States, ill..... 315, 324*b*, 334
Destroyer under way, ill..... 11
Destroying German kite balloons..... 21
Deullin, Albert: French ace, ill..... 572
D'Harcourt, Captain, ill..... 576
Diamond Shoals lightship..... 541
Dimensions of the crater of Katmai volcano.... 167
Dinner-pail, Their full: Pigs, ill..... 181
Dinner, Serving: Military hospital, Paris, ill..... 372
Diplomacy entered, Where kitchen..... 207
Diplomat, Commodore Perry a brilliant..... 326
Dirigible entering its hangar, French, ill..... 20
Dirigible flying: American aëronautical training station, ill. 83
Discovery, Few accidents in the world of..... 325
Distillery, Oil-shale: Juab, Utah, ill..... 200
Distilling rock for oil..... 197
Diving for coins: Socotra.....text, 268; ill., 277
Divisional or reconnaissance aviation..... 11
Doctrine, A dangerous and contagious..... 336
Doctrine, Prussian: "As we will it!"..... 549
Dog and rabbit: A millennial scene, ill..... 375*
Dog and skunk: Armed neutrality, ill..... 377*
Dog-cart, Refugees': France, ill..... 505
Dog mascot of the new *Texas*, ill..... 324*a*
Dogs and cats as pets, Pigs rival..... 181
Donkey and woman toil together: Spain..... 284
Don Quixote, Cart immortalized by..... 280
"Doping" the wings of airplanes, ill..... 55
Dorme, René: French ace..... text, 7, 569; ill., 572
Double-decker, A: Pigs, ill..... 182
Douglas squirrel..... ill. (colored), 444; text, 455
Drafted men, Parade of: Washington, D. C., ill. 566
Dragon's-blood trees: Socotra..... ill., 270; text, 273
Drawings, Lucien Jonas': French war scenes, ill. 355-355*b*
Dream of World Domination, Germany's. By the Editor 559
Dried fruits produced annually: Value..... 365
Dried tomato, Advantages of..... 364
Dried vegetable habit would change world agriculture, How the..... 361
Driggs, Laurence La Tourette. Aces Among Aces 568
Drilling, U S. sailors, ill..... 314, 321*a*, 325*a*
Drunkenness, No soldiers' camps ever before so free from 227
Dry-dock: Ship being washed, ill..... 327, 329, 389
Drying at home is important: Vegetables..... 365
Drying companies, American..... 367
Drying companies, Canadian..... 368
Drying factory, Vegetable: Canada, ill... 363*a*-*b*, 366
Dunant, M. Henri: At the battlefield of Solferino 383
Dunant's efforts bear fruit at Geneva..... 385
Dunant, Vision and plan of..... 383
Duroc Jersey pigs, ill..... 178, 179
Dutch white-potato mill: Reported output..... 361
Dye, Edward T.: Selling W. S. S. in New York City, ill. 389

"E"

Each camp a great city..... 231
Eagles of Combat and Defense, Italy's. By Gen. P. Tozzi 38
East and West meet: Methods of transportation, ill. 29
Eastern chipmunk..... ill. (colored), 440; text, 447
Eastern chipmunk: Tracks, ill..... 477
Eastern States, Oil deposits in..... 199
Eastport harbor, Maine: "Old Friar" rock..... 513
Educating the immigrant, ill..... 351-351*b*, 353
Educational work, Red Cross..... 390
Eiffel tower arches, Paris, France, ill..... 307
"Elephant," or French observation balloon, ill... 24
Ellis, William T.: Voyaging on the Volga Amid War and Revolution..... 245
Employees, Shipyard, ill..... 347*a*, 347*b*
Endowment Fund, American Red Cross..... 387
Enemy's morale, Shattering the..... 3, 25
Engineering class afloat: U S. Navy, ill..... 316
Engine, Life of an airplane: 100 hours..... 61
Engines, Airplane: Student aviators, ill..... 76
England aroused by war correspondent's dispatch 375
English for the immigrant: Demonstration lessons, ill. 351, 351*a*
Entomologist with his bug net: Katmai Valley, Alaska, ill..... 135
Epicurean tastes, Our expensive..... 859
Epilogue, A mean and bitter..... 575
Equilibrium test: Aviation, ill..... 72
Erard, Captain: Aviator..... 7
Escaping destruction by a miracle: Aviation.... 101
Europe, Map: Food and war, ill..... 338
Europe: Map of the Western Theatre of War (supplement) 371*
Europe, portions wanted by Germany..... 559
Every generation has had its war..... 313
Every soldier must be an expert..... 223
Expedition to Alaska: National Geographic Society, 1917. By Robert F. Griggs, Leader..... 115
Exploits of the late Captain Ball, Some of the: British Air Service..... 27
Exploration, Navy's work in science and..... 318
Explorers, Three most eminent naval..... 325
Exports, Socotran 277

"F"

Factory, Airplane: United States, ill..... 48-62
Factory, Vegetable drying: Canada, ill. 363*a*, 363*b*, 366
Fair at Nizhni Novgorod, Russia..... 247
Fairchild, David: Agricultural Explorer in Charge of Foreign Seed and Plant Introduction, U. S. Department of Agriculture. Forming New Fashions in Food..... 356
Fake batteries to deceive scout planes..... 15
Falling Mountain, Katmai Valley, Alaska...text, 131, 141; ill., 136, 140
Falling test: Aviation, ill..... 72, 73
Famine, Charts showing deaths by fighting and, ill. 337
Famine, Forerunners of. By Frederick C. Walcott 336
Farmers being taught through their sons..... 183
Farming: Spain 284
Farm scene, Canada: Pumpkin field, ill..... 193
Farm scenes: United States, ill..... 192, 194, 564
Father and son: Lighthouses, Cape Henry, Va., ill. 516
"Father of the Steam Navy": Commodore Perry. 326
Fear driven away by work: Katmai Expedition, 1917 153
Feats of daring, Thrilling: Aviation..... 103
Fed amazingly for four francs a day: France... 101
Ferocity, Concentrated: Animals..... 375*
Ferret, Black-footed.... ill. (colored), 449; text, 469
Fête day in St. Julian..... 297
Field bakery: National Guard camp, ill..... 227
"Field for Germany, A magnificent"..... 563
Field mouse, or meadow mouse.....text, 403; ill. (colored), 420
Field mouse: Track, ill..... 393
Field-workers: France, ill..... 368
Fighting, Charts showing deaths by famine and, ill. 337
Fighting planes, Tactics of..... 19
Fighting the pest in German prison camps: Cooties 507
Filing fittings for airplane wing spars, ill..... 53
Fire Island Lightship..... 541
Firing a broadside, U. S. S. *New Hampshire*, ill. 317*a*
First cross-country flight, The: Stuart Walcott... 93
First view of the Ten Thousand Smokes: Alaska. 117
First Virginia Field Artillery in training, Chickamauga, ill. 224
Fish caught by hand: Alaska, ill..... 164
Fisherman, Socotran: "Gogglywoggle".....text, 268; ill., 275
Fissures, Katmai Valley, Alaska..... 134
Fissure Lake, Katmai Valley, Alaska.. text, 139, 140; ill., 146
Fissure, Steaming: Katmai, Alaska, ill..... 131
Fittings, Airplane: In the making, ill..... 53, 62
Flag formed of 10,000 bluejackets, ill..... 228
Flag, French: Red Cross canteen, Paris, ill..... 377
Flag, Italian: Warehouse at Rome, ill..... 387
Flag, Pledging allegiance to the: U. S. shipbuilders, ill 347*a*, 347*b*
Flag, Rag-pickers' Union: Spain... text, 279; ill., 294
Flag, Red Cross, ill..... 382, 387
Flag, Red Cross: Adopted 1864..... 386
Flags, French: Strassburg monument, ill..... 304

Page

Flags on the graves of American dead: France, ill. 508
Flag, United States: Katmai Expedition, 1917, ill. 169
Flag, U. S.: On a submerging submarine, ill.... 324c
Flag, U. S.: Red Cross canteen, Paris, ill... 377, 384
Flag, United States: Warehouse at Rome, ill.... 387
Flapjack feast in camp: Katmai Expedition, 1917, ill. 160
Flashlight photography, Animal, ill. 380*
Flasks, Shop of skin: Seo d'Urgel, Spain..... 295
Flea and rat pest: Trenches..... 501
Flight across the Adriatic, The: Italian airmen.. 41
Flood in the Katmai Valley, Effects of the, ill... 165
Florence Nightingale accomplished in the Crimea, What 381, 386
Florence Nightingale's nursery novitiate..... 378
Florida, U. S. S.: Sick bay, ill..... 330
Flour barrel, Allies': Chart showing supply and demand, ill..... 344
Flour, Potato, two kinds of..... 362
Flour, Price per barrel: Chart, ill..... 345
Flour, Sweet-potato, Virtues of..... 361
Flour, White-potato: Reported Dutch mill output 361
Flowers of pure sulphur: Katmai Valley, Alaska. 139
Flyer in a bean patch, A..... 92
Flyers, Aiding the Government in training..... 110
"Flying Cadet" in training..... 83, 85
Flying in a Nieuport..... text, 95; ill., 570
FLYING IN FRANCE. BY CAPT. ANDRÉ DE BERROETA, OF THE FRENCH AVIATION SERVICE 9
Flying schools, American: Airplanes, ill..... 88, 90, 97, 100
Flying squirrel..... ill. (colored), 449; text, 466
Flying, Studying the mysteries of, ill..... 75
Fly is dangerous at the front, The..... 501
Fogg, George W.: Geneva Conference..... 385
Folding wings, Airplane with, ill..... 31
Following an airplane wing through its manufacture 54
Fonck, of the Cigognes: Aces Among Aces..... 568
Fonck, René: French ace, ill..... 569
Fonck reveals his secret: Aces Among Aces..... 569
Food Administration has done for us, What the.. 343
Food and war map of Europe, ill..... 338
Food charts showing supply and demand, ill. 341, 344
Food controllers, Problems of..... 342
Food essentials, Two newly discovered..... 357
Food, Forming New Fashions in. By David Fairchild 356
Food: Katmai Expedition, 1917..... 155
Food law enacted, 1917: Effect, ill..... 345
Food Problem, Helping to Solve Our Allies'. By Ralph Graves 170
Food, Prussian soldiers stripping Polish homes of, ill. 339
Foods, Our limited range of..... 356
Food: The part food plays at the front..... 340
Food the principal occasion of excitement: Volga ports 263
Foraging as a fine art: Russia..... 263
Fording creek near Mt. Mageik, Alaska, ill..... 157
Foreign-born illiterates in United States: Chart showing increase, ill..... 350
FORERUNNERS OF FAMINE. BY FREDERIC C. WALCOTT..... 336
FORMING NEW FASHIONS IN FOOD: THE BEARING OF TASTE ON ONE OF OUR GREAT FOOD ECONOMIES, THE DRIED VEGETABLE, WHICH IS DEVELOPING INTO A BIG WAR INDUSTRY. BY DAVID FAIRCHILD 356
Fortnightly Review, 1871, describes Prussianism.. 555
Fort Snelling, Minn.: Y. M. C. A. building in camp, ill. 220
Fosdick Outside Activities Association: Liberty theaters in camps..... 227
Four little pigs, ill..... 190
Four transcontinental airways..... 113
Fox squirrel..... ill. (colored), 445; text, 459
Fox squirrel: Tracks, ill..... 478, 479
France, American army in, ill..... 207, 210, 212, 215, 217
France, American railway station in, ill..... 212
France, Bayonet practice by U. S. marines in, ill. 242
France: Chart showing deaths by fighting and famine, ill. 337
France, Field-workers in, ill..... 368
France, Life Story of an American Airman in... 86

Page

France, Northern, is vital to Germany..... 567
France, Paris: Scenes, ill..... 302, 304, 306-308, 310, 312, 370-373
France: Peasants and their ruined homes, ill.... 339a
France, Post-graduate course in: Aviation..... 86
France, St. Brieuc: Market day, ill..... 187
France: Scenes taken from airplanes, ill.... 2, 8, 10, 17, 18, 26
France, Score of the living and dead aces of.. 575-577
France, Shopping Abroad for Our Army in. By Herbert Corey 206
France: Village scenes, ill..... 505, 506
Frankincense trees: Socotra, ill... 269, 270, 272, 276
Frankincense blossoms and fruit: Socotra, ill.... 269
Freedom, Bolshevik idea of..... 248
Freight steamer: Great Lakes, ill..... 548
French aces, ill..... 4, 569, 572, 573, 577
French aces, Record of..... 575-577
French airplane welcomes American battleship, ill. 6
French attacks viewed from observation airplanes, ill. 8, 26
French aviation mission to America, ill..... 4
French drawing by Lucien Jonas, ill..... 355-355b
French frontier, Spanish town inside the: Llivia. 279, 289
French Military Mission coöperating with U. S. Purchasing Board 211
French warplane, 125-miles-an-hour, ill..... 36
French women to can for American soldiers..... 216
"Friend of all the world, America will be the".. 294
Fruit and blossoms, Frankincense: Socotra, ill... 269
Fruits, dried, produced annually: Value..... 365
Fuertes, Louis Agassiz: Animal paintings, ill. (colored), 404, 405, 408, 409, 412, 413, 416, 417, 420, 421, 424, 425, 428, 429, 432, 433, 436, 437, 440, 441, 444, 445, 448, 449, 452, 453, 456, 457, 460, 461, 464, 465
Fullard, Philip F.: Royal Flying Corps..... 572
Fumaroles, Katmai district, Alaska (supplement), 115; ill., 120, 122, 130; text, 123
Fumes and cave-ins feared: Katmai district, Alaska 121
"Fund, Delousing": Germany..... 507
Fur-folk homes, Peeps into..... 381*
Furry friends and enemies..... 371*
Fuselage, Skeleton of an airplane's, ill..... 56
FUTURE OF THE AIRPLANE, THE. BY REAR ADMIRAL ROBERT E. PEARY, U. S. NAVY..... 107

"G"

Gardens in miniature on lumber rafts: Russia... 248
Gare de l'Est, Paris: Red Cross canteens, ill. 377, 380
Gas attack, French: Viewed from an airplane, ill. 26
Gas-emitting vent, Katmai Valley, Alaska, ill... 133, 135, 151
Gasoline sponge-bath for writhing soldiers..... 506
Gas samples, Collecting: Katmai Valley, Alaska 129, 137
GEM OF THE OCEAN, THE: OUR AMERICAN NAVY. BY JOSEPHUS DANIELS... 313
Genesis of the United States Sanitary Commission 386
Geneva, Dunant's efforts bear fruit at..... 385
Geneva Society of Public Utility..... 385
"Geneva Treaty," or 1864 Convention..... 385
Geography and color: animals..... 374*
Geography, Knights of..... 323
Geologists at work on oil shale, Government, ill. 196, 199, 201-203
Georgia, U. S. S.: Pacific Ocean, ill..... 318
Gerard, James W.: Quotation..... 567
German airplanes, ill..... 12, 38, 99
German and Austrian aces, Record of..... 578, 579
"German autocracy went mad, Until the"..... 387
German confession, A sinister..... 549
German conspirators, Watch long kept on..... 553
German Empire area before the war..... 559
German "honor" to hold Belgium, A matter of... 565
German kite balloons, Destroying..... 21
German planes are disposed in three stories..... 19
German prison camps, Fighting the pest in: Cooties 507
German trenches from an airplane, ill..... 102
Germany: Charts showing deaths by fighting and famine, ill. 337
Germany counterfeits rubles..... 342

Page

Germany, Industrial conditions in..... 340
Germany raises potatoes for alcohol..... 205
GERMANY'S AIR PROGRAM..... 114
Germany's dream: Map, ill..... 558
GERMANY'S DREAM OF WORLD DOMINATION. BY THE EDITOR..... 559
Germany's object, World dominion..... 547
Germany's use of the white-potato..... 363
Germany's war leaders, Quotations from.... 561-567
Germany, The case of the world against..... 221
Germany uses famine as a weapon..... 336
Germs are not suspected, Where: Russian peasants 264
Geysers, Why there are no: Katmai district, Alaska 131
Geysers, Yellowstone Park number a hundred.... 131
Gibraltar of the American seacoast, A..... 521
"Gift of a victorious war, The": Germany's dream 565
Glacial age: Atlantic coast..... 521
Gnawers most numerous of mammals..... 374*
Goethe's estimate of the Prussians..... 555
"Gogglywoggle": Socotran fisherman..... text, 268; ill., 275
Golden chipmunk..... ill. (colored), 440; text, 443
Good-bye: Soldier leaving his wife and baby, ill.. 552
Good housekeeping in rodent land..... 377*
Gopher, Pocket..... text, 398; ill. (colored), 413
Government in training flyers, Aiding the..... 110
Governor Morton and *Prima Donna*: A great ocean race 334
Governors Island, N. Y.: Ruth Law, American aviatrix, ill. 111
Grain: Barometer of supply and demand, ill..... 341
Grand Valley, Colorado: Oil shale, ill..... 203, 204
Grass for a bed: Katmai Valley, Alaska, ill... ...164
Grasshopper mouse..... text, 418; ill. (colored), 425
Grasshopper mouse: Tracks, ill..... 468
Graves, American soldiers': France, ill..... 508
Graves, Ralph: Helping to Solve Our Allies' Food Problem 170
Gray squirrel..... ill. (colored), 445; text, 458
Great Lakes, Freight steamer on the, ill..... 548
Great Lakes Naval Training Station, ill., 64, 228, 229; text, 243
"Great Mageik Boulder Flow," Alaska..... ill., 159; text, 161
Great men will call us to "carry on"..... 325
Greece, Saloniki: From an airplane, ill..... 28
Greely, A. W., Major-General, U. S. Army: The National Geographic in War Time..... 369
Green River, Wyoming: Oil shale beds, ill..... 196
Griggs, Robert F., Director of the National Geographic Society Katmai Expeditions, 1915, 1916, and 1917. The Valley of Ten Thousand Smokes 115
Grooming a pig for the State fair, ill..... 172
Ground school: Aviation..... ill., 78; text, 83
Ground squirrel, California..... ill. (colored), 437; text, 439
Ground squirrel, Striped..... ill. (colored), 436; text, 438
Guidi, Lieutenant: Italian airman..... 47
Gum resin, Frankincense is a..... 267
Gun drill, Sailors practicing, ill..... 321*a*
Gun, Machine-: On a destroyer, ill..... 334
Guns: U. S. Navy, ill..... 315, 315*b*, 317*a*, 318, 319, 321, 321*b*, 333
Gun, U. S. infantryman's ill..... 552
Guynemer, Georges: French ace.. text, 7, 568, 569; ill., 572, 576

"H"

Habitudes are changing, The American's..... 360
Hadibo, Socotra: Capital of the island..... 267
Hagelbarger, Paul R., Assistant Botanist, Katmai Expedition, 1917: Testimony..... 148
Haghier, Peaks of: Socotra..... 267
Hail of pumice, Katmai district, Alaska..... 117
Haleakala, Hawaii: Area..... 168
Hamilton, Lord, ill..... 576
"Hammer of God, We are the": Prussianism.... 551
Hammocks, Sleeping: U. S. S. *North Dakota*, ill. 329*b*
Hancock, Camp: Soldiers in training, ill.... 225, 241
Handley-Page bombing machine, British, ill..... 36
Hands and faces go unwashed: Russian peasants.. 260
Hangar, American aeronautical training station, ill. 83
Hangar, French dirigible entering its, ill..... 20

Page

Hangars, Italian, ill..... 41, 42
Harbor, New York: Liberty and her defenders, ill. 325*b*
Harbors, Atlantic coast, ill..... 531, 537
Harbors, Atlantic coast: Nature's Red Cross stations 545
Harden, Maximilian: Quotations..... 565
Hare, Arctic.....text, 389*; ill. (colored), 408
Hare, Little chief, cony, or pika.....text, 392; ill. (colored), 409
Hare, Varying, or snowshoe rabbit.....text, 387*; ill. (colored), 405
Hare, Varying, or snowshoe rabbit; Tracks, ill.. 388*
Harvesting corn, ill..... 194
Harvest mouse.....text, 415; ill. (colored), 425
Harvest scene: France, ill..... 368
Hasse, Ernst: Quotations..... 563
Headgear, Formidable: Russian peasants..... 261
HEALTH AND MORALE OF AMERICA'S CITIZEN ARMY, THE: PERSONAL OBSERVATIONS OF CONDITIONS IN OUR SOLDIER CITIES BY A FORMER COMMANDER-IN-CHIEF OF THE UNITED STATES ARMY AND NAVY. BY WILLIAM HOWARD TAFT..... 219
HELPING TO SOLVE OUR ALLIES' FOOD PROBLEM: AMERICA CALLS FOR A MILLION YOUNG SOLDIERS OF THE COMMISSARY TO VOLUNTEER FOR SERVICE IN 1918. BY RALPH GRAVES..... 170
Herbert, Sidney, and the Red Cross spirit... 377, 380
Heroes, Hospital..... 510
Heroes, Living in the midst of..... 5
Heroes without glory..... 497
Heurteaux, Albert: French ace..text, 7; ill., 572, 576
Highland Light, Mass.: Coast scene, ill..... 522
High-record shirt: Cooties..... 509
Hine, James S., Zoölogist, Katmai Expedition, 1917: Testimony..... 150
Hirsute effulgence, Examples of: Russia..... 257
H. M. S. *Canning* and its kite balloon, ill..... 35
Hoary bat, text..... 491
Hoary marmot, or whistler.....ill. (colored), 433; text, 434
Hog and corn ratio is 13 to 1..... 343
Hog-nosed skunk.....ill. (colored), 457; text, 479
Hogrel, Commander: French ace, ill..... 572
Hogs: Barometer of supply and demand, ill..... 341
Holy pool, Jerusalem, ill..... 30
Home canning must not be discouraged..... 364
Home drying is important: Vegetables..... 365
Honorary membership in the National Geographic Society extended to President Wilson. 369
Horse cart: Spain, ill..... 287
Horse-play and songs lighten the toiling hours: Volga stevedores..... 261
Horses of Neptune, White, ill..... 333
Hospital Heroes Convict the "Cootie"..... 510
Hospital room, Naval vessel, ill..... 330
Hospitals, Military: France, ill..... 370-373, 379
Hospitals, Terrible conditions in: Crimea..... 380
Hospital ward in France, National Geographic Society's 373
Hostess House for soldiers, ill..... 229
Hotel de Ville, Andorra, ill..... 284
Hotel de Ville: Puigcerda, Spain..... 293
Hot springs, Yellowstone Park number 4,000.... 131
House mouse.....text, 427; ill. (colored), 429
Houses, Stone: Andorra Republic, ill... 286, 291, 292
How the dried-vegetable habit would change world agriculture..... 361
Hubbe-Schleiden: Quotation..... 567
Human history, Darkest page in..... 338
Humanitarian movement, greatest of modern times: Red Cross. By Stockton Axson..... 375
Hunger forces Roumania to peace..... 337
Hunting the Hun in the blue Atlantic, ill..... 235
Hurricane, U. S. S. *New York* in a, ill..... 319, 333
Hydro-airplane, Giant: In the making, ill..... 58
Hydro-airplane, Naval: On a battleship, ill..... 108
Hydro-airplane, Navy aviators with, ill..... 324
Hydro-airplane: Port Washington, Long Island, ill. 66
Hydro-airplanes, Italian, ill..... 43
Hydro-plane: Atlantic coast, ill..... 520
Hygiene and sanitation for the immigrant: Demonstration lesson, ill..... 351*a*

Page

"I"

Ice and atmosphere, Water's allies..... 513
Ice as a land ally: Nature's warfare..... 521
Illiterates in United States: Chart showing increase and decrease, ill..... 350
Immigrant, Educating the, ill..... 351, 351*b*, 353
Immigrant illiterates in the United States: Chart showing increase, ill..... 350
India, Conquest of: Germany's dream..... 567
Industrial conditions in Germany..... 340
Industries, Socotran..... 278
Industry, Smuggling is an: Andorra Republic. By Herbert Corey..... 279
Infantry and spotting planes..... 19
Inferno, The modern: Valley of Ten Thousand Smokes, Alaska..... 150
Ingram: Destroyer named for chief gunner's mate..... 321*b*
Ingram, Osmun K.: Tribute to his bravery..... 321*b*
Inoculation tests: Soldier volunteers..... 510
Insect powder used by soldiers at the front..... 508
Insects, Dead: Katmai Valley, Alaska..... 129
Insects: Trench pests..... 495
Insignia, Airplane, ill..... 36, 45, 62, 99, 570, 577
Insignia, Red Cross: Adopted in Geneva, 1864.. 386
Instruction, Many special courses of: Air army. 80
International law, The navy studies..... 314
Interpretation of aërial photographs..... 15
Intrigue set afoot, Vast: German leaders..... 551
Inventions to Japan, Taking western..... 327
Investments in Liberty Loans: National Geographic Society..... 372
ISLE OF FRANKINCENSE, THE. BY CHARLES K. MOSER..... 267
Italian aces, Record of..... 578
Italian airplanes, ill..... 39, 41-44, 46
Italian children refugees at Palermo: Drinking soup, ill..... 346
Italian hangars, ill..... 41, 42
ITALIAN RACE, THE—AN APPRECIATION. BY THE EDITOR..... 47
Italy, Chart showing deaths by fighting and famine, ill..... 337
Italy, Rome: Red Cross supplies, ill..... 376, 387
Italy, Solferino: Birthplace of the Red Cross spirit..... 383
ITALY'S EAGLES OF COMBAT AND DEFENSE: HEROIC ACHIEVEMENTS OF AVIATORS ABOVE THE ADRIATIC, THE APENNINES, AND THE ALPS. BY KINDNESS OF GENERAL P. TOZZI, CHIEF OF THE ITALIAN MILITARY MISSION.. 38
Italy, Under three flags in, ill..... 387

"J"

Jackh, Ernst: Quotation..... 563
Japan, Taking western inventions to..... 327
Jennings self-recording color-sense tester..... 82
Jerusalem, British airplane over, ill..... 30
Johns Hopkins University, Rat specimens from, ill..... 357-360, 363
Jonas, Lucien: French drawings, ill..... 355-355*b*
Jones, E. W.: Originator of the boys' pig-club movement..... 171
Juab, Utah: Old shale distillery, ill..... 200
Judgstaffel No. II: German air squadron..... 574
Jumping mouse.....text, 394; ill. (colored), 412
Junior Auxiliary of the Red Cross..... 390
"Just in": Soldiers from the trenches..... 300

"K"

Kaibab squirrel.....ill. (colored), 448; text, 462
Kaiser's worship of ruthless conquerors..... 561
Kangaroo rat.....text, 400; ill. (colored), 416
Kangaroo rat, Hand-fed, ill..... 373*
Katmai, Ascent of: Alaska..... 162
Katmai Canyon, Climbing out of: Alaska, ill.... 163
Katmai crater, compared with Kilauea, Hawaiian Islands.....ill., 167; text, 168
Katmai District of Alaska, The Valley of Ten Thousand Smokes. By Robert F. Griggs..... 115
Katmai Pass, Alaska, ill..... 118, 140, 158
Katmai, the greatest active crater in the world: Alaska..... 168
Kazan, Russia: Volga port..... 262

Page

Kilauea crater dimensions compared with Katmai volcano.....ill., 167; text, 168
Kirchhoff, Hermann: Quotation..... 565
Kiss, A pig's, ill..... 184
Kiss: Baby kissing soldier father good-bye, ill... 552
Kitchen, American rolling: War zone, ill..... 499
Kitchen, Arabian: Aden, ill..... 272
Kitchen battery: Portable ranges, ill..... 230
Kitchen diplomacy entered, Where..... 207
Kitchen, Red Cross canteen: Paris, ill..... 384
Kite balloon, ill..... 35
Kite balloon on observation duty, ill..... 85
Kite balloons, Destroying German..... 21
Knights of Columbus in camp..... 227
Knights of Geography..... 323
Kodiak bear, In the path of the, ill..... 152

"L"

L-45, Tangled remains of the: France, ill..... 14
Laboratory specimens, rats: Johns Hopkins University, ill..... 357-360, 363
Labor-saving devices lacking in Russia..... 262
"Labor, Why not import American": France.... 218
Lafayette Escadrille..... 5, 568
Lafayette Escadrille, Quartered with heroes of the..... 98
La Garde, Paul de: Quotation..... 563
Lagoon and boat-houses Great Lakes Training Station, ill..... 64
La Gorce, John Oliver: A Battle-Ground of Nature: The Atlantic Seaboard..... 511
Lake, Fissure: Katmai Valley, Alaska..text, 139, 340; ill., 146
Land assumes the offensive, When the: Nature's warfare..... 523
Landing field, Aviator's, ill..... 112
Lane, Franklin K., Secretary of the Interior: What Is It to Be an American?..... 348
Lange, Friedrich: Quotation..... 563
Langley airway, The proposed..... 113
Language: Socotra..... 277
Lansing, Robert, Secretary of State: Prussianism 546
Large weasels, or stoats.....ill. (colored), 452; text, 469
Laundry work done without waiting: Bluejacket, ill..... 326
Laureati, Captain: Italian airman..... 47
Lava plug of Novarupta, Katmai Valley, Alaska, ill., 138; text, 145
Law, Food, enacted 1917: Effect, ill..... 345
Law, Ruth: American aviatrix, ill..... 111
Law, The Navy studies international..... 314
Law vindicated, Selective draft..... 244
Leadership could accomplish in Russia, What... 253
Least weasel.....ill. (colored), 452; text, 471
Legend of the Sirens of Socotra..... 269
Lemming, Banded.....text, 401; ill. (colored), 417
Lemming, Brown.....text, 402; ill. (colored), 417
Lentils grown in Socotra..... 269
Les Escaldes, Andorra Republic, ill..... 291
Lethe, River: Katmai Valley, Alaska.....text, 140; ill., 141
Letters from Stuart Walcott. An American Airman in France..... 86
Leutwein, Paul: Quotation..... 565
Liberia location chosen by Commodore Perry... 326
Liberty and her defenders: Battleships, ill..... 325*b*
Liberty Loans, Investments in: National Geographic Society..... 372
Liberty theatre in camp..... 227
Library in a battleship, ill..... 327*b*
Life-boat, Parachute is the balloonist's, ill..... 32
Life of an airplane engine only 100 hours..... 61
Life-savers: U. S. coast guards..... 541, 545
Life-saving boat and crew, ill..... 540
LIFE STORY OF AN AMERICAN AIRMAN IN FRANCE: EXTRACTS FROM THE LETTERS OF STUART WALCOTT, WHO, BETWEEN JULY AND DECEMBER, 1917, LEARNED TO FLY IN FRENCH SCHOOLS OF AVIATION, WON FAME AT THE FRONT, AND FELL NEAR SAINT SOUPLET..... 86
Life story of a pig-club pig..... 177
Life story of the louse family..... 501
Lighthouses: Atlantic seaboard, ill..... 516, 523
Lighthouses, U. S..... 538

Page

Lightness and strength, A maximum of: Airplanes.....ill., 48; text, 55
Linen for airplane wings.....ill., 49, 55; text, 55
Lines of national suspicion to be obliterated..... 322
Little spotted skunk.....ill. (colored), 456; text, 474
Living in the midst of heroes..... 5
Llivia, "a Spanish village in France"..... 279, 289
Llivia, Spain: Scenes, ill..... 292, 293, 295
Loading a transport with troops and supplies for France, ill..... 208
Long Island beaches and shifting sands..... 523
Loop-the-loop over Newport News, Va., ill..... 68
Louse causes trench fever and typhus..... 501
Louse family, The life story..... 501
Louse habits during the war..... 509
Lubricant from the castor-oil bean..... 48
Lufberry, Raoul: American ace..text, 7, 571; ill., 570
Lumber rafts on the Volga.....text, 248; ill., 252
Lumber resources, Straining America's..... 53
Lynn Harbor, Mass.: Map, ill..... 534

"M"

McCudden, James Byford: Royal Flying Corps.. 572, 573
Machine, Delousing: Cootie pest, ill.... 496, 500, 503
Machine-gun on a destroyer, ill..... 334
Machine-gun, Studying the anatomy of a, ill.... 74
Madrid, Spain: Rag-picker's cart, ill..... 294
Mageik boulder flow: Alaska, ill..... 159
Mageik volcano, Alaska..... 161
"Magnificent field for Germany, A"..... 563
Mail service outlined, Aërial..... 110
Maine coast, Battlements of the: Nature's warfare 513
Mammals, The Smaller North American. By E. W. Nelson..... 371*
Man-and-woman power, America rich in aviator. 109
Man as a profiteer in Nature's war..... 538
Map, Europe: Food and war, ill..... 338
Map: Germany's Dream of World Domination, ill. 558
Map, Outline: Valley of the Ten Thousand Smokes 155
Maps: Atlantic seaboard, ill..... 533-535
Map: Spain, showing Andorran Republic location 281
Map: Western Theatre of War (supplement).... 371*
Marblehead, Mass.: Rocky coast..... 521
Marine scenes: Atlantic seaboard, ill....512, 514-516, 518-520, 522, 523, 525, 526, 529-532, 536, 537, 540, 542, 543
Marine scenes in war time, ill..... 315*a*, 315*b*, 317*a*-319, 321, 323, 324*b*, 324*c*, 325*b*, 327*a*, 329*a*, 331*a*, 333
Marines in France, U. S., ill..... 210
Marines, Mascot of the: War zone, ill..... 504
Market day for pigs, ill..... 186, 187, 191
Market scene: Astrakhan, Russia, ill..... 247, 260
Marmot, American, or common woodchuck.text, 431; ill. (colored), 432
Marmot, American: Tracks, ill..... 475
Marmot, Hoary, or whistler.....ill. (colored), 433
text, 434
Marsh rabbit.....text, 391; ill. (colored), 409
Marten, or American sable.....ill. (colored), 453; text, 473
Martin Valley and Martin Volcano, Exploring... 161
Mascot of the *Texas:* Boston bull, "Buster," ill. 324*a*
Mascot, U. S. marines: War zone, ill..... 504
Masts, Fighting: Battleship, ill..... 315*a*, 317*a*, 317*b*, 321, 321*b*, 329*a*
Matinicus light..... 539
Matter of German "honor" to hold Belgium..... 565
Maury, Matthew Fontaine: Naval hero..... 329
Maury, Wilkes, and Perry: Naval explorers..... 325
Maynard, Clarence F., Topographer, Katmai Expedition, 1917: Testimony..... 149
Meadow mouse, or field mouse.....text, 403; ill. (colored), 420
Meadow mouse: Tracks, ill..... 393
Mechanic repairing a motor in the air: France, ill. 23
Medals decorating a policeman: Russia, ill..... 254
Medical Corps of the Navy, Work of the..... 315
Medical staff in the Air army..... 61
Melons grown in Socotra..... 269
Members of the Katmai Expedition, 1917, ill.... 156

Page

Mental examination is not formidable: Aviation. 82
Men whose hearts are in their work..... 216
Metal fittings for America's airplanes: In the making, ill..... 53, 62
Mexican bat.....ill. (colored), 465; text, 491
Mice, Nest of young white-footed, ill..... 379*
Midland, Texas: Jack Starr and his champion pig 179
Military clique of Berlin, Deceived by..... 554
Military Hospital No. 1, U. S.: Paris, ill.... 370-372
Military relief association, First permanent: United States..... 385
Milk-fed pig, ill..... 173
Mill, Dutch white-potato: Reported output..... 361
Millennial scene: Rabbit-hound and a young rabbit, ill..... 375*
Mimic combat in the air, A..... 104
Minaret, Approaching the habitat of the: Russia. 262
Mineola Camp military aviation school, ill..... 65
Mineral wealth, America's immense..... 205
Miniature gardens on lumber rafts: Russia..... 248
Mink, American.....ill. (colored), 453; text, 472
Mink, American: Tracks, ill..... 482, 483
Mink taking its own picture, ill..... 380*
Minot Ledge light..... 539
Mison, France: Captured Zeppelin, ill..... 14
Mississippi River delta: Map, ill..... 533
Mississippi, U. S. S., ill..... 315*b*
Mitchell, Guy Elliott, of the United States Geological Survey: Billions of Barrels of Oil Locked up in Rocks..... 195
Mocha coffee, Roasting: Arabia, ill..... 272
Modes of attack: Airplanes..... 19
Mokalla, Arabia..... 278
Mole, Oregon.....ill. (colored), 461; text, 484
Mole, Star-nosed.....ill. (colored), 461; text, 485
Monument, Strassburg, Alsace memorial, ill..... 304
Moonlight on the water: Atlantic coast, ill..... 526
Moral courage needed to bear trench pests..... 499
Morale and Health of America's Citizen Army. By William Howard Taft..... 219
Morale, Shattering the enemy's..... 3, 25
Mormon shale distillery near Juab, Utah, ill..... 200
Moser, Charles K., Formerly United States Consul-General to Aden, Arabia: The Isle of Frankincense 267
Mosques, Tatar: Astrakhan, Russia..... 262
Motor, Airplane: Student aviators, ill..... 77
Motto and coat of arms: Andorra Republic, ill.. 284
Moujik, Spring beds unknown to the: Russia.... 251
Mountain-beaver.....text, 427; ill. (colored), 432
Mountain country resembling Colorado: Spain... 281
Mt. Callahan, Colorado: Oil-bearing rock, ill.... 204
Mt. Cerberus, Katmai Valley, Alaska.....text, 130; ill., 130, 140
Mt. Desert light..... 539
Mt. Katmai, Alaska.....ill., 140, 166, 168; text, 158
Mt. Mageik, Katmai Valley, Alaska.....text, 139; ill., 140, 157
Mt. Martin, Alaska.....ill., 140; text, 161
Mouse, Beach.....text, 422; ill. (colored), 428
Mouse, Big-eared rock...text, 423; ill. (colored), 429
Mouse, Field or Meadow.....text, 403; ill. (colored), 420
Mouse, Field or Meadow: Tracks, ill..... 393
Mouse, Grasshopper.....text, 418; ill. (colored), 425
Mouse, Grasshopper: Tracks, ill..... 468
Mouse, Harvest.....text, 415; ill. (colored), 425
Mouse, House.....text, 427; ill. (colored), 429
Mouse, Jumping.....text, 394; ill. (colored), 412
Mouse, Pine.....text, 406; ill. (colored), 420
Mouse, Red-backed.....text, 407; ill. (colored), 421
Mouse, Rufous tree.....text, 410; ill. (colored), 421
Mouse, Silky pocket....text, 395; ill. (colored), 413
Mouse, Spiny pocket....text, 396; ill. (colored), 413
Mouse taking its own picture, ill..... 378*
Mouse, White-footed....text, 419; ill. (colored), 428
Mouse, White-footed: Tracks, ill..... 470
"Movie" show on a battleship, ill..... 320
Mud, Blue: Katmai Valley, Alaska..... 139
Mud Canyon, Katmai Volcano, Alaska, ill..... 132
Mud mark, High: Katmai Valley, Alaska, ill.... 142
Mud, solidified: Katmai Valley, Alaska, ill.. 148, 149
Mules, American army: France, ill..... 212
Mules, Chief traffic is in Spanish: Andorra..... 299
Muscle balance test: Aviation, ill..... 70
Music, Russian love of..... 262
Muskrat.....text, 411; ill. (colored), 424
Muskrat: Tracks, ill..... 467

"N"

Page

Nahant, Mass.: Map, ill. 534
Nahant, Mass.: Pulpit Rock, ill. 514
Names that will inspire the future navy. 320
Nantucket Lightship 539
Napoleon, Tomb of: Paris, France, ill. 312
National Army men in training, ill. 556
National Geographic Society: Appeal to members. 347
NATIONAL GEOGRAPHIC SOCIETY IN WAR TIME. BY MAJOR-GENERAL A. W. GREELY, U. S. ARMY. 369
National Geographic Society: Notable achievements 170
National Geographic Society's Katmai Expedition, 1917: Members, ill. 156
National Geographic Society's Mount Katmai Expedition, 1917: The Valley of Ten Thousand Smokes. By Robert F. Griggs. 115
National suspicion to be obliterated, Lines of. 322
Nature's Battle-Ground: The Atlantic Seaboard. By John Oliver La Gorce. 511
Nature's warfare: Atlantic seaboard, ill.. 512, 514-516, 518-520, 522-526, 528-537, 540, 542-544
Nature's warfare, Communiques of. 521
Nature's wild-folk: Tracks, ill. 383*
Naval activities, By-products of. 316
Naval base, Austrian: Cattaro. 45
Naval explorers, Three most eminent. 325
Naval hydro-airplane on a battleship, ill. 108
Naval Observatory transformed by Maury. 332
Naval training station, ill. *222*, 314, 316, *321a*, *325a*, 328, *331b*
Navesink light 541
Navy aviators with hydro-airplane, ill. 324
Navy in peace, The, ill. *324d*
Navy, Our American, ill. 314-316, *317a-321b*, *323-324d*, *325a-331b*, 333, 334, 389
Navy, Our American: The Gem of the Ocean. By Josephus Daniels. 313
Navy studies international law. 314
Needs difficult to foresee: Air army. 60
Nelson, Edward W., Chief, United States Biological Survey. "Smaller Mammals of North America" 371*
Neptune, white horses of, ill. 333
Nest of young red squirrels, ill. 398
Nest of young white-footed mice, ill. 379*
Neuilly, U. S. Military Hospital No. 1 at, ill.. 370-372
Neutral road to Livia, ill. 293
New coats for Boreas' court. 381*
New Hampshire, U. S. S, ill. *317a*
New order of warriors will fare forth, A. 322
Newport News, Va.: Loop-the-loop, airplaine, ill. 68
Newport, R. I.: Naval training station, ill.. *222*, 328
New York City buildings would not fill Katmai crater 169
New York City daily water supply. 168
New Yorl City: Master Edward T. Dye selling W. S. S., ill. 389
New York City: Woolworth tower and a Caproni biplane, ill. 46
New York Harbor: Liberty and her defenders, ill. *325b*
New York, U. S. S.: In a hurricane, ill.... 319, 333
Nieuport, Flying in a. text, 95; ill., 570
Nieuport, The wild man in the. 92
Night-flying airplane, ill. 579
Night flying, Aviator's sign-post for, ill. 112
Nightingale, Florence: During the Crimea.. 381, 386
Nightingale, Florence: Nursery novitiate. 378
Nights and days in the trenches. 503
Nine-banded armadillo... ill. (colored), 457; text, 480
Nizhni Novgorod, Russia: Daily life. text, 246; ill., 250, 251, 254
No army is cleaner than America's. 509
Noisy Mountain, Katmai Valley, Alaska.... ill., 144; text, 144
Non-stop flights, New world records for: Italian airmen 47
Norfolk, Va.: Sunrise on the water, ill. 531
North America, Germany's aspirations in. 561
North Dakota, U. S. S.: Sleeping hammocks, ill. *329b*
No soldiers' camps ever before so free from drunkenness 227
"Nothing stands alone". 390
Novarupta Volcano, Katmai Valley, Alaska..text, 131 144; ill., 138, 140, 145
Nungesser, Charles: French ace..... text, 7; ill., 577
Nurse, Red Cross: Military hospital, Paris, ill... 373

Page

Nursery novitiate, Florence Nightingale's. 378
Nursing, Scientific: Modern system developed by Florence Nightingale 383
Nutritive value, Potato's great. 362
"Nystagmus test": Aviation, ill. 71

"O"

Oats: Barometer of supply and demand, ill. 341
Observation balloon above a battleship, ill. 84
Observation balloon before its inflation with hydrogen gas, ill. 80
Observation balloons used in war, ill. 17, 22, 24, 25, 32, 35, 80-85
Observation work: Student aviators, ill. 79
Observers, Military: Training camps, ill.... 230, 232
Ocean race, A great: *Governor Morton* and *Prima Donna* 334
Ocean, The Gem of the: Our American Navy. By Josephus Daniels. 313
Odors, A bewildering complex of: Katmai Valley, Alaska 137
Oil Locked up in Rocks, Billions of Barrels of. By Guy Elliott Mitchell. 195
Oil profitably distilled from shale in Scotland... 195
Oil-shale beds: Western United States, ill... 196-204
Oil-shale industry in America will outstrip Scotland 202
Oil used by Volga River craft. 248
"Old Friar," rock in Eastport harbor. 513
One of America's air triumphs. 51
"One Volunteer": French drawing, ill. 355*a*
Oregon chipmunk. ill. (colored), 441; text, 450
Oregon mole. ill. (colored), 461; text, 484
Origin of the word Socotra. 277
Ormond-Daytona Beach, Fla., ill. 528
Outline map: Valley of Ten Thousand Smokes... 155
Out of the storm: Airplane, ill. 69
"Over the top and at 'em," Learning how to go, ill. 241
Oxen: Spain, ill. 290, 295
Ozarks: Hogs with wooden yokes, ill. 176

"P"

Pacific Ocean: U. S. S. *Georgia* in a typhoon, ill. 318
Painted barns as signs to aviators, ill. 112
Painted chipmunk. ill. (colored), 441; text, 451
Painting the distinguishing star: American airplane, ill. 62
Palace of the Trocadero and the Eiffel tower: Paris, France, ill. 307
Palmerston, Quotation from. 317
"Pants rabbits": Trench pests. 497
Parachute is the balloonist's life-boat, ill. 32
Parade of drafted men: Washington, D. C., ill.... 566
Paris, France: Military hospitals, ill. 370-373
Paris, France: Scenes, ill.. 302, 304, 306-308, 310, 312
Paris: Red Cross service, ill. 377, 380, 382, 384
Part food plays at the front. 340
"Pass-word" shot from an airplane, ill. 34
"Past pointing" test: Aviation, ill. 73
Patriotic meetings, Shipbuilders', ill. *347a*, *347b*
Patriotic posters, ill. 550
Patriots may enlist, How young. 191
Peace born of kindness, A. 329
Peace, Navy in: U. S., ill. *324d*
Peace, Relation of Prussianism to. 546, 547
Peary, Robert E., Rear-Admiral, U. S. Navy: The Future of the Airplane. 107
Peasants, French: Eating their crust of bread, ill *339a*
Peasants, Russian: Life on the Volga. 245
Peeps into fur-folk homes. 381*
Pennsylvania avenue, Washington, D. C., ill. 566
Pennsylvania, U. S. S., ill. *317b*
Perambulating steam-table: Hospital, Paris, ill.. 372
Perry, Matthew Calbraith: Brilliant diplomat and naval hero 326
Perry, Matthew C.: "Father of the Steam Navy" 326
Perry, Maury, and Wilkes: Naval explorers. 325
Pershing's big task, General. 209
Personnel, Great problems of: Air army. 57
Personnel, Katmai Expedition, 1917. 154
Pest, Fighting the trench: German prison camps. 507
Pests, Trench: Cooties and Courage. By Herbert Corey 495
Pet-sheep movement, ill. 192
Pets, Pigs rival dogs and cats as. 181
Phinny's tribute to Maury. 335

Page

Photographing leaves and flowers of the Frankincense: Socotra, ill. 270
Photographs. Interpretation of aërial 15
Photographs taken from airplanes, ill. 2, 8, 10, 11, 17, 18, 26, 28, 34, 37, 67-69, 100, 102
Photography, Animal flashlight, ill. 380*
Photophysicists and the air army 60
Physical training: Naval station, ill. 314, 325a
Piccio, Colonel: Italian airman 47
Pictures, Animals taking their own, ill. 378*-380*
Pictures, Moving: On a battleship, ill. 320
Pig-club member *vs.* the "practical" farmer 172
Pig clubs, Beginnings of 171
Pig clubs, Boys and girls 170
Pig families, ill. 175, 177, 180-182, 185
Pigs and chickens travel with the family: Russian peasants 259
Pig's kiss, A, ill. 184
Pigs rival dogs and cats as pets 181
Pika, little chief hare, or cony text, 392; ill. (colored), 409
Pine mouse text, 406; ill. (colored), 420
Place Vendôme, Paris, France, ill. 310
PLAIN TALES FROM THE TRENCHES: AS TOLD OVER THE TEA TABLE IN BLIGHTY—A SOLDIERS' "HOME" IN PARIS. BY CAROL K. COREY 300
Plant life destroyed, Katmai Valley, Alaska 129
"Plant our foot where it appears important": Prussianism 562
Plaza de la Constitucion: Llivia, ill. 295
Pocket gophers text, 398; ill. (colored), 413
Poland: Chart showing deaths by fighting and famine, ill. 337
Polecat, spilogale, or little skunk: Tracks, ill. 488
Policeman at Nizhni Novgorod, Russia, ill. 254
Polish homes stripped of food by Prussian soldiers, ill. 339
"Political curiosity, It is a": Andorra 297
Pómilio factory, Mammoth hangar of the, ill. 42
Population: Andorra Republic 299
Population: Socotra 277
Porcupine text, 393; ill. (colored), 412
Portals, Hotel de Ville, Andorra, ill. 284
Portland Head Light, Cape Elizabeth, Me., ill. 523
Porto Rico: Packing pigs to market, ill. 186
Ports, Volga River: Russia ill., 246, 247, 252, 254, 258, 260, 264; text, 262
Port Washington, Long Island: Hydro-airplane, ill. 66
"Possession of Northern France is vital": Prussianism 567
Posters, Patriotic, ill. 550
Post-graduate course in France: Aviation 86
Post-office, Camp: Corner in correspondence, ill. 226
Potatoes raised for alcohol: Germany 205
Potato flour, Two kinds of 362
Potato mill, Dutch white-: Reported output 361
Potato's great nutritive value 362
Potato, Sweet, possibilities of 361
Potato, White-, situation 361
Potpourri of races: Russia 255
Powder, insect, used by soldiers at the front 508
"Practical" farmer *vs.* the pig-club member 172
Prairie-dog text, 434; ill. (colored), 436
Premier Escadrille: Aces Among Aces 568
Prevention the watchword of the Sanitary Commission 386
Price of flour per barrel: Chart, ill. 345
Prices, Our method of fixing 342
Prima Donna and *Governor Morton:* A great ocean race 334
Prince of Wales, ill. 576
Princeton school of aviation: Students, ill. 234
Prison camps, German: Fighting the trench pest. 507
Problems of food controllers 342
Profiteering falls upon the wage-earner, Burden of 343
Profiteer in Nature's war, Man as a 538
Profiteers will be dead, Days when 324
Propaganda, The necessity for 222
Propeller, Airplane: In the making, ill. 57
Prussian boar's tusks must be drawn 388
Prussian doctrine: "As we will it!" 549
PRUSSIANISM. BY ROBERT LANSING 546
Prussianism, Central thought of 547
Prussianism described in 1871: *Fortnightly Review* 555
Prussian soldiers stripping Polish homes of food, ill. 339
Psychologists in the air army 61

Page

Public Square, Llivia, Spain, ill. and text 292
Public Utility, Geneva Society of 385
Puigcerda, Spain: Description 284
Puigcerda, Spain: Old rope-walker, ill. 298
Pulpit Rock, Nahant, Mass., ill. 514
Pumice, Hail of: Katmai district, Alaska 117
Pumice, Lumps of: Katmai, Alaska, ill. 145
Pumpkin field: Canada, ill. 193
Punching machine in an airplane parts factory, ill. 50
"Punch the clock": Immigrant school, ill. 353
Purchasing officer achieves results, How the: U. S. Army 209
Putnam, David E.: American ace 572

"Q"

Quadruped with biped track: Common cat, ill. 385*
Quotations from Germany's war leaders 561-567

"R"

Rabbit, Antelope jack...text, 384*; ill. (colored), 404
Rabbit, Antelope jack: Tracks, ill. 386*
Rabbit, California jack..text, 385*; ill. (colored), 405
Rabbit, California jack: Tracks, ill. 386*
Rabbit, Cottontail.....text, 390*; ill. (colored), 408
Rabbit, Cottontail: Tracks, ill. 390*
Rabbit-hound and a young rabbit, ill. 375*
Rabbit, Marsh.....text, 391; ill. (colored), 409
Rabbit, Snowshoe, or Varying hare.....text, 387*; ill. (colored), 405
Rabbit, Snowshoe, or Varying hare: Tracks, ill.. 388*
Race, A day-and-night: Air industry 56
Race, A great ocean: *Governor Morton* and *Prima Donna* 334
Races: A potpourri of: Russia 255
Racing crew of the Atlantic fleet, Champion, ill. 229
Radio, Battle's progress sent by 16
Radiotelegraphy used on airplanes: France 15
Rafts, Lumber: Volga River, Russia.....text, 248; ill., 252
Raft, Socotran native: "Gogglywoggle"....text, 268; ill., 275
Rag-pickers union flag: Spain.....text, 279; ill., 294
Rail fence: Ozarks, ill. 176
Railroad cars lost and found 214
Railroads playing a major rôle: U. S. Army in France 213
Railway station in France, American, ill. 212
Rainbow, Deposits all colors of the: Katmai Valley, Alaska 139
Rainfall, U. S. average 511
"Rampart of Verdun": French drawing, ill. 355
Range-finding instruction: Training camp, ill. 237
Rat and flea pests: Trenches 501
Rat, Brown.....text, 423; ill. (colored), 429
Rat, Brown: Tracks, ill. 472
Rat, Kangaroo.....text, 400; ill. (colored), 416
Rat, Kangaroo: Hand-fed, ill. 373*
Rats, laboratory specimens: Johns Hopkins University, ill. 357-360, 363
Raw material for a matchless army: Russia 248
Raymond, Lieutenant: French ace, ill. 572, 573
Reading-room, Ship's, ill. 327*b*
Reconnaissance machines in Italian factory, ill. 42
Reconnaissance or Divisional Aviation 11
Reconnaissance training, ill. 232
Recreation hour in camp, ill. 229, 221, 233, 234
Recreation: Military Hospital, Paris, ill. 371
Recreation: Red Cross canteen, ill. 378
Red-backed mouse.....text, 407; ill. (colored), 421
Red bat.....ill. (colored), 464; text, 489
Red Cross, American: In Europe, ill. 339*b*, 346
Red Cross Association, First organized practical: United States Sanitary Commission 386
Red Cross educational work 390
Red Cross flag, ill. 382, 387
Red Cross flag adopted in Geneva, 1864 386
Red Cross service to mankind, ill. 376-382, 384, 387
Red Cross spirit born at Solferino 383
Red Cross stations, Harbors: Nature's warfare 545
Red Cross, the Symbol of Service to Mankind. By Stockton Axson 375
Red Cross workers, National Geographic Society's 375
Red squirrel.....ill. (colored), 444; text, 454
Red squirrels and their nest, ill. 398
"Reformatory" authors, Age of: England 376

Page

Refrigerator, Our: Katmai Expedition to Alaska, ill. ... 124
Refugees, Italian: Palermo, ill. ... 346
Refugees' mode of travel, France, ill. ... 505
Refugees, Red Cross supper for: Paris, ill. ... 382
Refugees, Serbian: Belgrade, ill. ... 339*b*
Relation of Prussianism to peace ... 546
"Replacement" man a cootie danger source ... 504
Republics are ungrateful, Why men say ... 335
Resin, Frankincense: How gathered ... 274
Resin, Silver fir tree ... 267
Resolutions concerning the death of Henry Fitch Blount ... 371
Revolving-chair tests: Aviation ... ill., 71-73; text, 82
Rheumatism cured by vapors: Valley of Ten Thousand Smokes, Alaska ... 124
Richard, Jean: French airman, ill. ... 573
Richthofen, Manfred von: German ace ... 574
Ring-tailed cat ... ill. (colored), 460; text, 482
Ripoll, Spain: Carrier's cart, ill. ... 287
River craft, An endless procession of: Volga River ... 265
River Lethe, Katmai Valley, Alaska ... text, 140 ill., 141
River Seine: Paris, France, ill. ... 308
Rivers: Voyaging on the Volga, Russia. By William T. Ellis ... 245
Road to Llivia, Neutral, ill. ... 293
Rock, "Old Friar": Eastport, Maine ... 513
Rocks, Oil locked up in ... 195
Rocks shot from the mountain, Huge: Katmai Valley, Alaska ... ill., 136, 144, 145, 159; text, 142
Rocks that burn freely ... 195
Rodent land, Good housekeeping in ... 377*
Rohrbach, Paul: Quotation ... 565
Rolling kitchen, American: War zone, ill. ... 499
Roll of aces of all belligerents ... 575
Rome, Italy: Red Cross supplies, ill. ... 376, 387
Rope splicing: Naval training station, ill. ... 240
Rope-walk: Puigcerda, Spain ... text, 293; ill., 298
Roumania: Charts showing deaths by fighting and famine, ill. ... 337
Roumania to peace, Hunger forces ... 337
Royal Flying Corps, High-score ace of the ... 572
Rubles, Germany counterfeits ... 342
Rufous tree mouse ... text, 410; ill. (colored), 421
Ruins of Zoko, Socotra ... 277
Ruler, Socotra's: Sultan Hassan ibn Imad ... 267
Russell, William Howard: English war correspondent ... 375
Russia: Chart showing deaths by fighting and famine, ill. ... 337
Russia like a child reaching for a butterfly ... 349
Russian aces, Record of ... 578
Russian soldiers on a Volga steamer, ill. ... 256
Russians like the "Americanski" ... 255
Russia: Voyaging on the Volga amid War and Revolution. By William T. Ellis ... 245
Rusty fox squirrel ... ill. (colored), 445; text, 459
Rusty fox squirrel: Tracks, ill. ... 478
Rye: Barometer of supply and demand, ill. ... 341

"S"

St. Brieuc, France: Market day, ill. ... 187
St. Julian, Fête day in ... 297
Sable, American, or marten ... ill. (colored), 453; text, 473
Safety-valve, Ten Thousand Smokes a vast ... 116
Sailing vessels: Atlantic seaboard, ill. ... 512, 529, 531
Sailors sewing shirts, ill. ... 242
Sailors, United States: At work and play, ill. ... 314, 315, 315*b*, 316, 320, 321*a*, 321*b*, 324*a*, 325*a*, 326, 327*a*-329, 329*b*, 330, 331*b*, 334, 389
Salmon caught by hand: Alaska, ill. ... 164
Salomone, Captain: Italian airman ... 45
Saloniki from an aëroplane, ill. ... 28
Salute, Explaining the necessity of the ... 226
Salvage crew hoisting an enemy airplane, ill. ... 38
Samara, Russia: Volga port ... 262
Sand-bag ballast, Adjusting: Captive balloon, ill. 81
Sand-dunes: Atlantic seaboard, ill. ... 519, 522, 524, 532, 536, 542, 544
Sand-dunes, Winds the makers of ... 535
Sands are led captive, When the: Nature's warfare ... 527
Sandy Hook an advance guard: Nature's warfare 523

Page

Sandy Hook, N. J.: Map, ill. ... 535
Sanitary Commission, United States ... 385, 386
Sanitary Corps, A universal sign adopted for the. 386
Sanitation and hygiene for the immigrant: Demonstration lesson, ill. ... 351*a*
San Marco, Island of: Bombarded by Italian airmen ... 45
Santa Coloma, Andorra Republic, ill. ... 285
Sant Antoni, Bridge of: Andorra, ill. ... 288
Saratov, Russia: Volga port ... 262
"Sardana" National Catalan dance, Andorra, ill. 296
"Sausage" balloon, French, ill. ... 25
"Sausage" balloons: American aëronautical training station, ill. ... 83
Sayre, J. D., Assistant Botanist, Katmai Expedition, 1917: Testimony ... 149
Scenes without parallel in the Western world: Volga steamer ... 257
Schellendorf, General Bronsart von: Quotation ... 563
School, American Flying: Airplanes, ill. ... 88, 90, 97, 100
School, Immigrant, ill. ... 351-351*b*, 353
School, Naval training, ill. ... 314, 316, 325*a*, 331*b*, 328
Schools, Aviation training: United States, ill. ... 63-65, 70-79
Science and exploration, Navy's work in ... 318
Scientific experiments with the "cootie" ... 510
Scientific nursing, Florence Nightingale developed the modern system of ... 383
Scotland, Oil distilled from shale in ... 195
Scout planes, Fake batteries to deceive ... 15
Scout planes, Formidable task of the ... 16
Screen, Smoke: Camouflage of the sea, ill. ... 324*b*, 327*a*
Sea dog's tribute to a comrade, A ... 335
Sea doomed to defeat: Nature's warfare ... 546
Sea encounters cross-fire resistance, When the: Nature's warfare ... 517
"Seam squirrels": Trench pests ... 497
Seasick in the air ... 101
Sea's submarines: Nature's warfare ... 527
Seductive influence on free transportation: Russia 249
Seine, a view of the: France, ill. ... 308
Selective draft law vindicated ... 244
Semaphore and wig-wag signaling: Naval training station, Newport, R. I., ill. ... 222
Sense of responsibility is vital: Air army ... 81
Sentinel of the sky: Italian airplane, ill. ... 39
Seo d'Urgel, Spain ... 294
Serbia: Chart showing deaths by fighting and famine, ill. ... 337
Serbian children of tragedy at Belgrade, ill. ... 339*b*
Serbian Relief Commission in Belgrade, ill. ... 339*b*
Seton, Ernest Thompson: Animal tracks, ill. ... 383*, 385*, 386*, 388*, 390*, 393, 467, 468, 470, 472, 475, 477-479, 481-483, 487, 488, 490
Setting-up exercises: Camp Hancock, ill. ... 225
Sewing shirts for sister Susie's sailor, ill. ... 242
Sham battle in the sky: Airplanes, ill. ... 100
Shattering the enemy's morale by air raids ... 3, 25
Sheep: Pennsylvania farm, ill. ... 192
Sheiks of the Socoteri, ill. ... 274
Shelf drill at a naval station, ill. ... 314
Shells of the sea, The 42-centimeter: Nature's warfare ... 517
Shifting land reserves at Atlantic City; Nature's warfare ... 527
Shipbuilders, Patriotic, ill. ... 347*a*, 347*b*
Shipley, L. W., Chemist, Katmai Expedition, 1917: Testimony ... 151
Ships, Atlantic coast, ill. ... 512, 518, 519, 529, 531
Ship's mast and an observation balloon, ill. ... 22
Ship's reading-room, Crew in a, ill. ... 327*b*
Ships, U. S. Army supply, ill. ... 208, 217
Shipwrecks: Atlantic seaboard, ill. ... 512, 518, 529
Shirt, High-record: Cooties ... 509
Shop of skin flasks: Seo d'Urgel, Spain ... 295
SHOPPING ABROAD FOR OUR ARMY IN FRANCE. BY HERBERT COREY ... 206
Short-tailed shrew ... ill. (colored), 464; text, 487
Short-tailed shrew, or Blarine: Tracks, ill. ... 490
Shrew, Common ... ill. (colored), 464; text, 486
Shrew, Short-tailed ... ill. (colored), 464; text, 487
Shrew, Short-tailed: Tracks, ill. ... 490
Sick bay: U. S. S. *Florida*, ill. ... 330
Siege. A town ready for a: Llivia ... 289
Signaling: Naval training station, Newport, R. I., ill. ... 222
Sign-post for night flying, Aviator's, ill. ... 112
Silky pocket mice ... text, 395; ill. (colored), 413

Page

Silver fir tree, Resin of the..... 267
Simbirsk, Russia: Volga port..... 262
Sing, even though you suffer..... 262
Singing an important feature of camp life.. ill., 233; text, 243
Sinister German confession..... 549
Sirens of Socotra, Legend of the..... 269
Skeleton of an airplane's fuselage, ill..... 56
Sketch maps: Atlantic seaboard, ill..... 533-535
Sketch map: Spain..... 281
Skin flasks, Shop of: Seo d'Urgel, Spain..... 295
Skunk and dog: Armed neutrality, ill..... 377*
Skunk, Common.....ill (colored), 456; text, 477
Skunk, Common: Tracks, ill..... 487
Skunk, Hog-nosed..... ill. (colored), 457; text, 479
Skunk, Little spotted.. ill. (colored), 456; text, 474
Skunk, Little spotted: Tracks, ill..... 488
Skunk never hurries: Why the..... 376*
Skunk, Polecat, or Spilogale: Tracks, ill..... 488
Sky sentinels above the Alps: Italian airmen, ill.. 39
Sky, Sham battle in the: Airplanes, ill..... 100
Slades among the nations..... 322
Sleeping hammocks: U. S. S. *North Dakota*, ill... 329*b*
SMALLER MAMMALS OF NORTH AMERICA. BY EDWARD W. NELSON..... 371*
Smoke screen, Camouflage of the sea, ill... 324*b*, 327*a*
Smokes, Valley of Ten Thousand: Alaska, ill. (supplement), 115, 116, 118, 120, 122, 124-128, 130-133, 135, 136, 138, 140-146, 148-152, 154-160, 163-169
Smoking valleys, A complicated system of: Katmai district, Alaska..... 130
Smugglers reaping a golden harvest: Andorra... 297
Smuggling is an Industry: Andorra Republic. By Herbert Corey..... 279
Snow-drift, Ash-covered: Katmai, Alaska, ill. 124, 158
Snow-drifts, Warm water from: Katmai Valley, Alaska..... 140
Snowshoe rabbit, or Varying hare.....text, 387*; ill. (colored), 405
Snowshoe rabbit: Tracks, ill..... 388*
Society of Public Utility, Geneva..... 385
Socotra: The Isle of Frankincense. By Charles K. Moser..... 267
Socotra's early civilization..... 276
Soldier kissing his baby good-bye, ill..... 553
Soldiers, American Expeditionary Forces, ill. 496, 498-500, 502-504, 506, 508
Soldiers, French: Drawings by Lucien Jonas, ill. 355-355*b*
Soldier, French: Invalided home, ill..... 339*a*
Soldiers, German: Stripping Polish homes of food, ill..... 339
Soldiers' "Home" in Paris, Blighty—A.....text, 300; ill., 302
Soldiers, Russian: On a Volga steamer, ill..... 256
Soldiers, U. S., ill..... 554, 556, 560
Soldiers, U. S.: France, ill.....207, 210, 212, 215
Soldiers volunteer for inoculation tests..... 510
Soldiers, Wounded: Military hospital, Paris, ill. 371-373, 379
Solferino, Italy: Birthplace of the Red Cross spirit..... 383
Solidified mud, Katmai Valley, Alaska, ill... 148, 149
"Solo" flight, Ready for a: Balloon, ill..... 82
Somaliland, Warsangli country: Frankincense... 267
Sombart, Werner: "Plant our foot where it appears important"..... 562
Songs and horse-play lighten the toiling hours: Volga stevedores..... 261
Soup kitchen, American Red Cross: Palermo, ill.. 346
South America, Portion wanted by Germany.... 559
South Magnetic Pole: Position determined..... 325
Spad, The strength of a..... 105
Spain and Switzerland, Predicaments of: World war..... 213
Spain drips with spies..... 288
Spain, Scenes in, ill..... 280, 287, 294, 298
Spanish mules, Chief traffic is in: Andorra..... 299
Spanish town inside the French frontier: Llivia, text, 279, 289; ill., 292, 293, 295
Spanish yoke, ill..... 290
"Speak for it": Boy feeding a pig, ill..... 188
Specimens, Manatee: Socotra..... 277
Spectacle of awesome magnitude: Valley of Ten Thousand Smokes..... 153
Speech, A submarine survivor's first..... 310
Spies, Spain drips with.....
Spilogale, Polecat, or Little Skunk: Tracks, ill... 488
Spiny pocket mice..... text, 396; ill., 413

Page

Spirit in America, A new..... 354
Splicing rope: Naval training station, ill..... 240
Sponge-bath, Gasoline: For writhing soldiers.... 506
Spotted skunk, Little.... ill. (colored), 456; text, 474
Spotting and infantry planes..... 19
Sprenger, A: Quotation..... 563
Spring beds unknown to the Moujik: Russia..... 251
Springman, Theodor: Quotation..... 567
Squadrons of Italian airplanes, ill..... 44
Squirrel, Abert.....ill. (colored), 448; text, 462
Squirrel and cat: Hereditary enemies, ill..... 372*
Squirrel, California ground.....ill. (colored), 437; text, 439
Squirrel, Douglas.....ill. (colored), 444; text, 455
Squirrel, Flying.....ill. (colored), 449; text, 466
Squirrel, Fox.....ill. (colored), 445; text, 459
Squirrel, Fox: Tracks, ill..... 478, 479
Squirrel, Gray.....ill. (colored), 445; text, 458
Squirrel, Kaibab.....ill. (colored), 448; text, 462
Squirrel, Red.....ill. (colored), 444; text, 454
Squirrel, Rustry fox.....ill. (colored), 445; text, 459
Squirrel, Rusty fox: Tracks, ill..... 478
Squirrels and their nest, Young red, ill..... 398
Squirrel, Striped ground..ill. (colored), 436; text, 438
Star, American distinguishing: Airplane wings, ill. 62
Starch, Potato..... 363
Star-nosed mole.....ill. (colored), 461; text, 485
Starr, Jack, and his champion pig..text, 176; ill., 179
Statue of Liberty: Distant view, ill..... 325*b*
Steam cranes used in unloading ships: France, ill. 217
Steamer, A Volga, ill..... 256, 258, 259
Steamer, Freight: Great Lakes, ill..... 548
Steam-heated tents, Valley of Ten Thousand Smokes,.....ill., 116; text, 123
Steam issues from solid rock: Katmai Valley, Alaska..... 143
"Steam Navy, The Father of the": Commodore Perry..... 326
Steam oven, Natural: Katmai Valley, ill....' 120, 122
Steam-table, Perambulating: Hospital, Paris, ill.. 372
Stereoscopic vision test: Aviation, ill..... 70
Stevedores, Russian: On the Volga....ill., 249, 258; text, 261
Stille, Charles J.: "History of the United States Sanitary Commission"..... 386
Still, Experimental oil: Colorado, ill..... 201
Stoat, or large weasel...ill. (colored), 452; text, 469
Stone houses: Andorra Republic, ill.... 286, 291, 292
Stoppani, Sergeant: Italian airman..... 47
Stores, Traveling: French villages, ill..... 506
"Storm flag of the empire": Prussianism..... 565
Storm, Out of the: Airplane, ill..... 69
Storms at sea, ill..... 318, 319, 333
Story of a bath: Soldier at Blighty..... 309
Story of Raoul Lufbery..... 571
Story of the Volga: Russia..... 245
Stoves: Army kitchen battery, ill..... 230
Strassburg monument: Alsace memorial, ill..... 304
Streams run red with blood: Europe..... 353
Strength and lightness, A maximum of: Airplanes..... ill., 48; text, 55
Striped ground squirrel...ill. (colored), 436; text, 438
Stuart, Edward (Mr. and Mrs.) of the Serbian Relief Commission, ill..... 339*b*
Submarine, American: Submerging, ill..... 324*c*
Submarine destroyer, ill..... 235
Submarine secondary to airplane..... 109
Submarines employed by sea: Nature's warfare.. 527
Submarine survivor's first speech, A..... 310
Sufferings of Russia unprecedented..... 349
Sugar-beet in America, Area of the..... 361
Sulphur, Flowers of pure: Katmai Valley, Alaska 139
Sultan Hassan ibn Imad, lord of the Isle of Frankincense..... 267
Sultan's deliberate affront: Socotra..... 271
Sunrise near Norfolk, ill..... 531
Sunset, Battleship *Pennsylvania* at, ill..... 317*b*
Sunset in Katmai Pass, Alaska, ill..... 118
"Supermen," ambition of Prussians..... 549
Supplies carried man back: Katmai Expedition, 1917..... 157
Supplies, U. S. Army, ill..... 207, 208, 212, 215, 217
Surgeons as non-combatants in war..... 386
Surgeons work after a great battle, How the.... 500
Surgical dressings, Stock of: Rome, ill..... 376
Sweet-potato as a dried vegetable..... 361
Swimming class at a naval training class, ill.... 325*a*
Switzerland and Spain, Predicaments of: World war..... 213
Switzerland: Geneva conferences, 1863, 1864.... 395

Page

SYMBOL OF SERVICE TO MANKIND: THE GREATEST HUMANITARIAN MOVEMENT OF MODERN TIMES ORIGINATED IN A PRACTICAL ATTEMPT TO MEET A PRACTICAL NEED WITH A PRACTICAL REMEDY. BY STOCKTON AXSON.. 375

"T"

Tactics of fighting planes..... 19
Taft, William Howard, elected member of the National Geographic Society's Board of Managers..... 371
Taft, William Howard: The Health and Morale of America's Citizen Army..... 219
TALES OF THE BRITISH AIR SERVICE. BY MAJOR WILLIAM A. BISHOP, V. C., D. S. O., M. C..... 27
Tamarida Bay, Socotra..... 267
Tango Circus: German air squadron..... 574
Tannenberg's forecast..... 562
Tarascon, Lieut.: French ace..... 7
Target range, Naval training station, Newport, R. I., ill..... 328
Task of the allied aces..... 580
Tastes, Our expensive epicurean..... 359
Tatar mosques: Astrakhan, Russia..... 262
Taube type of German airplane, ill..... 99
Teaching the farmer through his son..... 183
Teaching the immigrant, ill..... 351-351*b*, 353
"Telescopes" made in America, Their: Socotra.. 278
Temperature of a vent, Taking the: Katmai Valley, Alaska, ill..... 154
Tent, Steam-heated: Expedition to Alaska...ill., 116; text, 123
Tents, Troop: American aviation school camp, ill. 90
Testimony of the members of the Katmai Expedition, 1917..... 147
Tests for prospective aviators....ill., 70-73; text, 82
Texas, U. S. S.: Boston bull mascot, ill..... 324*a*
Texas, U. S. S.: Official family of the *Texas*, ill. 321*b*
Thaw, William: American ace..... 7
Theatres in camp, Liberty..... 227
Theuden, Rudolph: Quotation..... 563
Thiem, Robert: Quotation..... 567
Three prize-winners in one family: Boys' pig club..... 185
Thrilling feats of daring: Aviation..... 103
Thysson's amazing confession..... 561
Titan of volcanoes: Mt. Katmai, Alaska, ill..... 166
Titles once obtained are never relinquished: Andorra..... 299
Tobacco, Andorran..... 299
Tobacco grown in Socotra..... 269
Tomato, dried, Advantages of..... 364
Tomb of Napoleon: Paris, France, ill..... 312
Tons of transportation, Saving..... 364
Topographer, The complaint of a..... 149
Torpedo-boats marking the way for the airmen: Italy..... 41
"Totos": Trench pests..... 497
Tour, De La, Captain: Aviator, ill..... 576
Tower, Eiffel: Paris, France, ill..... 307
Tower, Woolworth: New York City, ill..... 46
Town crying, An art in..... 293
Town ready for a siege: Livia..... 289
Tozzi, Pasquale, General, Chief of the Italian Mission: Italy's Eagles of Combat and Defense 38
Tracks, Animal, ill.....383*, 385*, 386*, 388*, 390*, 393*, 467, 468, 470, 472, 475, 477-479, 481-483, 487, 488, 490
Tracks, Animal: Katmai Valley, Alaska..... 129
Traffic on a busy waterway: Volga, Russia..... 247
Training camp, Aviators: United States, ill.... 90, 97
Training station, Naval, ill..... 314, 316, 321*a* 325*a*, 328, 331*b*
Train, Troop: U. S. marines in France, ill..... 210
Train, Troop: U. S. soldiers, ill..... 560
Transcontinental airways, Four..... 113
Transportation, Ancient and modern methods of, ill..... 29
Transportation, Saving tons of..... 364
Transportation, Seductive influence of free: Russia..... 249
Transport for France, Loading a, ill..... 208
Traveling in France difficult in war times..... 98
Traveling in the sort of cart immortalized by Don Quixote..... 280

Page

Traveling stores: French villages, ill..... 506
Travel, Modes of: Spain, ill..... 280, 287
Treasures, What a family: Russia..... 257
"Treaty, Geneva," or 1864 Convention..... 385
Trees, Cucumber: Socotra..... 273
Trees, Dragon's-blood: Socotra....ill., 270; text, 273
Trees, Frankincense: Socotra.....text, 267; ill., 269, 270, 272, 276
Tremendous pressures must be withstood: Airplanes..... 52
Trenches, German: From an airplane, ill..... 102
Trenches, Plain Tales from the. By Carol K. Corey..... 300
Trench fever and typhus traced to the louse..... 501
Trench pests: Cooties and Courage. By Herbert Corey..... 495
Tribute, A sea dog's, to a comrade..... 335
Tribute to an enemy ace: Captain von Richthofen. 574
Tribute to Osmun K. Ingram..... 321*b*
Tribute to the American dead: France, ill..... 508
Tri-color and the Strassburg monument, ill..... 304
Trocadero, Palace of the: Paris, France, ill..... 307
Troops can be attacked by airplanes, How..... 22
Troop tents: American aviation school camp, ill. 90
Troop train: U. S. soldiers, ill..... 210, 560
Truck, Y. M. C. A.: War zone, ill..... 502
Truing the airplane: America's sky fleet, ill..... 52
Tulasne, Joseph, Captain, Chief of French Aviation Mission to America: America's Part in the Allies' Mastery of the Air..... 1
Turkey: Charts showing deaths by fighting and famine, ill..... 337
Turkish ace, Record of..... 579
Turnbuckles, Girls making airplane, ill..... 51
Tusks of the Prussian boar must be drawn..... 388
Two examples of Italy's air achievements..... 40
Two-seater airplanes: American flying school, ill. 88
Type of American officer in France..... 497
Typhoon, U. S. S. *Georgia* in a, ill..... 318
Typhus and trench fever traced to the louse..... 501
Tzaritzuin, Russia: Volga port..... 262

"U"

Under three flags in Italy, ill..... 387
Uniform: Great Britain's Royal Flying Corps, ill..... 33
Uniforms: French aviators, ill..... 4
Uniforms: U. S. Army aviators, ill..... 93, 105
Uniform, U. S. infantryman, ill..... 552
Union, Rag-pickers': Spain.....text, 279; ill., 294
UNIQUE REPUBLIC, WHERE SMUGGLING IS AN INDUSTRY, A. BY HERBERT COREY..... 279
United Kingdom: Chart showing deaths by fighting and famine, ill..... 337
United States:
Airplanes in the making, ill..... 48-62
Army aviator's uniform, ill..... 93
Atlantic Seaboard: A Battle-Ground of Nature. By John Oliver La Gorce..... 511
Aviation schools, ill..... 63-65, 90, 94, 97
Coast and Geodetic Survey, Nature's war correspondent..... 541
Coast Guards: Wearers of the cross..... 541, 545
Colorado, Grand Valley: Oil shale, ill... 203, 204
Colorado: Oil-shale beds, ill..... 196, 201
District of Columbia: Parade in Washington, ill..... 566
Florida, Alton Beach: An Aerograph, ill.... 67
Florida, Biscayne Bay: Aviation school machine, ill..... 63, 67
Florida coast scenes, ill..... 542, 544
Florida, Ormond-Daytona beach, ill..... 528
Food Administration has done for us, What the..... 343
Geological Survey: Testing oil rocks...text, 195; ill., 196-204
Georgia, Augusta: Camp Hancock, ill.. 225, 241
Georgia, Chickamauga: First Virginia Field Artillery in training, ill..... 224
Great Lakes, Freight steamer on the, ill..... 548
Great Lakes training station, ill..... 64
Illiterates, Chart showing increase and decrease in, ill..... 350
Long Island: Mineola aviation school, ill... 65
Long Island, Port Washington: Hydro-airplane, ill..... 66

Page

Louisiana, Caddo Parish: Original boys' pig club 171
Maine coast scenes, ill..... 523
Marines in France, ill..... 210, 242, 504
Massachusetts coast scenes, ill..... 514, 515, 522, 534
Military Hospital No. 1: Paris, ill..... 370-372
Minnesota, Fort Snelling: Y. M. C. A. building in camp, ill..... 220
Navy, Our American: The Gem of the Ocean. By Josephus Daniels..... 313
Navy, Our American, ill..... 314-316, 317a-321b, 323-324d, 325a-331b, 333, 334
New Jersey, Sandy Hook: Map, ill..... 535
New York City buildings would not fill Katmai crater..... 169
New York City daily water supply..... 168
New York City: W. S. S. campaign, ill..... 389
New York City: Woolworth tower, ill..... 46
New York Harbor: Liberty and her defenders, ill..... 325b
New York, Ruth Law at Governors Island, ill. 111
Pennsylvania farm scene: Sheep, ill..... 192
Record of the aces of the United States.... 577
Rhode Island, Newport: Naval training station, ill..... 222, 328
Sanitary Commission the first organized practical Red Cross Association..... 385, 386
Soldiers, ill..... 207, 208, 210, 212, 215, 220-221, 224-228, 232-237, 240-242, 496, 498-500, 502-504, 552, 554, 556, 560
United States not signatory to the 1864 Treaty: Geneva..... 385
U. S. S. *Arizona* at sea, ill..... 321
U. S. S. *Florida:* Sick bay, ill..... 330
U. S. S. *Georgia* in a typhoon, ill..... 318
U. S. S. *Mississippi*, ill..... 315b
U. S. S. *New Hampshire*, ill..... 317a
U. S. S. *New York* in a hurricane, ill... 319, 333
U. S. S. *North Dakota:* Sleeping hammocks, ill. 329b
U. S. S. *Pennsylvania*, ill..... 317b
U. S. S. *Texas:* Boston bull mascot, ill..... 324a
U. S. S. *Texas*, Official family of the, ill.... 321b
Utah: Oil-shale beds, ill..... 198, 200
Virginia coast scenes, ill..... 516, 531, 534, 536
Virginia, Newport News: Loop-the-loop, airplane, ill..... 68
Wyoming: Oil-shale beds, ill..... 196, 197
Universal history the history of the world's great men 325
Universal sign adopted for the Sanitary Corps.. 386
Universe will be ours for helping our fellow-men 319
Unold, Johannes: Quotation..... 563
Un Souvenir de Solferino: Henri Dunant..... 383
"Until the German autocracy suddenly went mad" 387

"V"

Valley of Ten Thousand Smokes, Alaska, ill. (supplement) 115, 116, 118, 120, 122, 124-128, 130-133, 135, 136, 138, 140-146, 148-152, 154-160, 163-169
VALLEY OF TEN THOUSAND SMOKES, THE: AN ACCOUNT OF THE DISCOVERY AND EXPLORATION OF THE MOST WONDERFUL VOLCANIC REGION IN THE WORLD. BY ROBERT F. GRIGGS, DIRECTOR OF THE NATIONAL GEOGRAPHIC SOCIETY KATMAI EXPEDITIONS OF 1915, 1916, AND 1917..... 115
Valley of Ten Thousand Smokes compared with Yellowstone Park..... 131
Valley of Ten Thousand Smokes named by Robert F. Griggs..... 115
Valley of Ten Thousand Smokes: Outline map.. 155
Vapors cured rheumatism: Valley of Ten Thousand Smokes, Alaska..... 124
Varennes, France: From an airplane, ill..... 18
Varying hares.....text, 387*; ill. (colored), 405
Varying hare: Tracks, ill..... 388*
Vegetable, dried, a war industry..... 356
Vegetable drying factory, ill..... 363a-363b, 366
Vegetables, Why do we eat..... 356
Vents, Gas-emitting: Katmai Valley, Alaska, ill. 133, 135, 151

Page

Verdun, Rampart of: French drawing, ill..... 355
Vest (Senator), Quotation from..... 333
Virginia Capes region..... 528
Virtues of sweet-potato flour..... 361
Vision and the plan of Dunant..... 383
Visitors regarded with justifiable suspicion: Llivia 279
Volcanic vents, Millions of: Katmai district, Alaska 119
Volcanoes, Alaskan: Valley of Ten Thousand Smokes .....text, 115-169; ill., 115-169
Volga steamers: Russia, ill.....256, 258, 259
Volga, Voyaging on the. By William T. Ellis.. 245
Volunteer, One: French drawing, ill..... 355a
VOYAGING ON THE VOLGA AMID WAR AND REVOLUTION: WAR-TIME SKETCHES ON RUSSIA'S GREAT WATERWAY. BY WILLIAM T. ELLIS.. 245

"W"

Wadi Motaha, Socotra: Caravan, ill..... 266
Wage-earner, The burden of profiteering falls upon the 343
Wagner, Klaus: Quotation..... 567
Walcott, Frederic C. Forerunners of Famine... 336
Walcott, Stuart: American aviator, ill..... 105
Walcott, Stuart, American airman in France: Extracts from the letters of Stuart Walcott..... 86
War and food map of Europe, ill..... 338
War between land and water..... 511
War correspondent's dispatch which aroused England 375
War, Every generation has had its..... 313
Warfare along the Florida Keys, Nature's..... 538
Warfare, Nature's: Atlantic seaboard, ill.. 512, 514-516, 518-520, 522-526, 528-537, 540, 542-544
War industry, The dried vegetable a..... 356
War Map: Western Theatre (supplement)..... 371*
Warm water from snowdrifts, Katmai Valley, Alaska.....text, 140; ill., 146
Warplane, French 125-miles-an-hour, ill..... 36
Warriors will fare forth, A new order of..... 322
Warsangli country, Somaliland: Frankincense... 267
War Savings Stamp campaign, National Geographic Society's 373
War Savings Stamps, Edward T. Dye selling: New York City, ill..... 389
War's birdmen to play useful rôle in peace times 109
War scenes: French drawings, ill..... 355, 355b
War scenes: French peasants, ill..... 339a
War scenes from airplanes, ill..... 2, 8, 10, 11, 17, 18, 26, 28, 34, 37, 67-69, 100, 102
War scenes: Polish homes robbed of food by Prussians, ill..... 339
War scenes: Serbian children of tragedy, ill..... 339b
War scenes, United States naval, ill..... 315a, 315b, 317a-321b, 323, 324b, 324c, 325b, 327a, 329a, 331a, 333, 334
War Time, National Geographic Society in. By Major-General A. W. Greely..... 369
War, Western Theatre of: Map (supplement).. 371*
War zone, American battleship using a smoke screen in the, ill..... 327a
Wash day in a U. S. Geological Survey camp, ill. 202
Wash day on a battleship, ill..... 326
Wash-houses, Community: France..... 505
Washing the ship in dry-dock, ill..... 327, 329, 389
Washington: Parade on Pennsylvania avenue, ill. 566
Watch long kept on German conspirators..... 553
Watchword of the Sanitary Commission, Prevention the 386
Water's allies in its air attacks..... 513
Water supply, Daily: New York City..... 168
Waves, Atlantic seaboard, ill..... 512, 514, 515, 518, 525, 530, 540, 543
Wearers of the cross: U. S. coast guards..... 541
"We are the hammer of God": Prussianism..... 551
Weasel at bay on a tree-trunk, ill..... 376*
Weasel, Large, or stoat..ill. (colored), 452; text, 469
Weasel, Large, or stoat: Tracks, ill..... 481
Weasel, Least.....ill. (colored), 452; text, 471
Weasel: Tracks, ill..... 481
Weather has many evil moods in the Valley of Ten Thousand Smokes, Alaska..... 127
Western inventions to Japan: Taking..... 327
Western Theatre of War: Map (supplement).... 371*
West Quaddy Head Light..... 538
What constitutes conspicuous bravery..... 573
What Florence Nightingale accomplished in the Crimea 381

Page

WHAT IS IT TO BE AN AMERICAN? BY FRANKLIN K. LANE..... 348
What leadership could accomplish in Russia.... 253
Wheat: Barometer of supply and demand, ill.... 341
Wheelbarrows of pigs for market: China, ill.... 191
When an American "outfit" enters a town..... 495
When the cadet first flies alone: Aviation..... 85
When the sea encounters cross-fire resistance.... 517
Whistler, or hoary marmot..... ill. (colored), 433; text, 434
White-footed mice, Nest of young, ill..... 379*
White-footed mouse.....text, 419; ill. (colored), 428
White-footed mouse: Tracks, ill..... 470
White horses of Neptune, ill..... 333
White-potato situation 361
White River, Colorado: Oil-shale beds, ill..... 196
Why men say republics are ungrateful..... 335
Wicker-bound pigs going to market: China, ill... 191
Wild man in the Nieuport, The..... 92
Wilkes, Charles: Naval hero..... 325
Wilkes Land 325
Wilkes, Perry, and Maury: Naval explorers..... 325
Wilson, President, marching in parade of drafted men, Washington, ill..... 566
Wilson, President, receives honorary membership in the National Geographic Society..... 369
Winds a Bolshevik army: Nature's warfare..... 535
Winds, makers of sand-dunes..... 535
Wine-sacks, Skin: Seo d'Urgel, Spain..... 295
Wings for the American birdmen, ill... 48, 49, 54, 55
Wings of victory, Women at work on the, ill.... 49
Wissemann, Lieutenant: German pilot..... 568
Wives travel with soldier husbands: Russia..... 250
Wolf tracks, Katmai Valley, Alaska..... 129
Wolverine tracks, Katmai Valley, Alaska..... 129
Woman and donkey toil together: Spain..... 284
Woman flyer: Ruth Law, ill..... 111
Woman power, America rich in aviator man-and- 109
Women field-workers: France, ill..... 368
Women sewing linen on airplanes: United States 55
Women soldiers, Russian..... 250
Women to can for American soldiers, French.... 216
Women workers in airplane factories, ill..... 48, 49, 50, 51, 53
Wonderful and amazing sight: Valley of Ten Thousand Smokes, Alaska..... 117, 119
Wonders of the World, One of the: Valley of Ten Thousand Smokes..... 115
Woodchuck, Common, or American marmot.text, 431; ill. (colored), 432

Page

Woodchuck, Common, or American marmot: Tracks, ill..... 475
Wooden yokes, Pigs with: Ozarks, ill..... 176
Wood, Leonard: Major General, U. S. Army, ill. 111
Woodrat.....text, 414; ill. (colored), 424
Woodrow Wilson airway, The proposed..... 113
Woolworth tower, New York City, ill..... 46
Work drove away fear: Katmai Expedition, 1917. 153
Work of the coast-guard cutters..... 545
World against Germany, The case of the..... 221
World agriculture, How the dried vegetable would change 361
World domination, Germany's dream of. By the Editor 559
World domination, Germany's dream of: Map, ill. 558
World dominion, supreme object of Germany... 547
World never again to be victimized by Prussian perfidy 555
World of discovery, Few accidents in the..... 325
World, One of the wonders of the: Valley of Ten Thousand Smokes..... 115
World's greatest battle, but not the last..... 354
World war: Charts showing death by fighting and famine, ill..... 337
World will be free again, When the..... 244
Wreaths and flags on the graves of the American dead: France, ill..... 508
Wright Brothers airway, The proposed..... 113

"Y"

Yams grown in Socotra..... 269
Yellowstone Park, Valley of Ten Thousand Smokes compared with..... 131
Yokes, Pigs with wooden: Ozarks, ill..... 176
Yoke, The Spanish, ill..... 290
Y. M. C. A. barracks for American fighters in Paris, ill..... 306
Y. M. C. A. in camp.....ill., 220, 221; text, 226
Y. M. C. A. truck of supplies: War zone, ill.... 502
Y. M. H. A., ill..... ... 227

"Z"

Zeppelins captured by French airmen. ill..... 12, 14
Zoko, Socotra: Ancient capital..... 277

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THE NATIONAL GEOGRAPHIC MAGAZINE

AMERICA'S PART IN THE ALLIES' MASTERY OF THE AIR

By Major Joseph Tulasne

Chief of the French Aviation Mission to America

THE summer of 1917 was marked by very spirited air battles for the supremacy of the air.

During those battles the losses of the Allies were great and those of our enemies still greater.

At the present time we are profiting by the lull which the winter rains have caused in air raids and are organizing large fleets of well-armed and well-equipped planes for the spring 1918.

The aërial program of the Allies is a mighty one; that of the enemies is just as mighty. Every one is convinced today of the importance of the supremacy of the air throughout 1918.

The American people have understood admirably the part which American aviation is to play in this gigantic struggle, and the enthusiasm of the American people and their determination to intervene in order to *blind* the army of the enemy has enabled Congress to pass an aviation bill calling for an appropriation of $640,000,000.

The officers in charge of the organization and development of American aviation and the business men who have spontaneously offered their services and business experience have done a great deal during the last six months. Aviation schools have sprung up all over the country. Several of them are at present working at full speed. Hundreds of pilots, full of dash, are being trained, and they are going about their work with the same zeal which they formerly displayed on the football field at college.

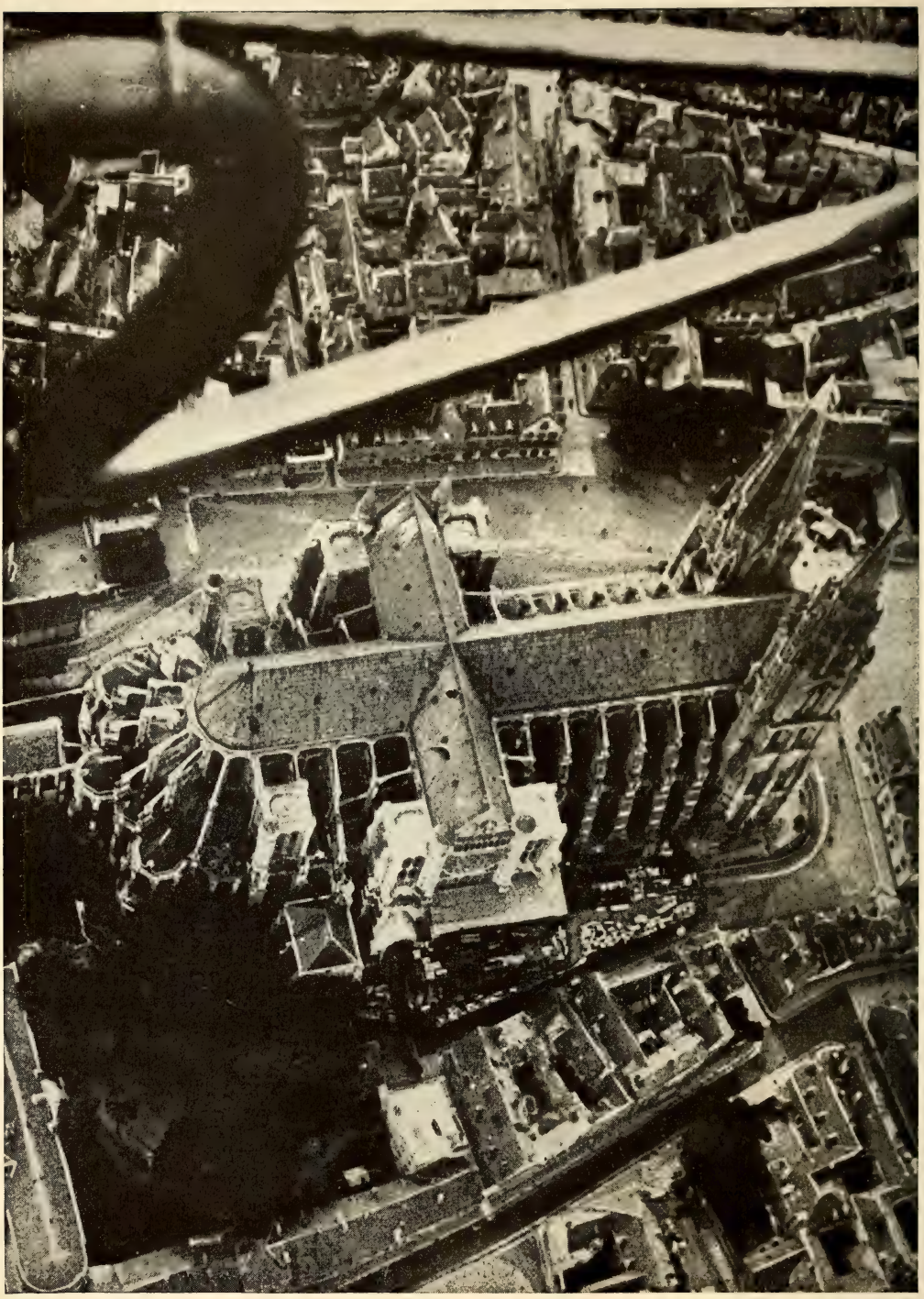
ARRIVAL OF AMERICA'S AIR FLEET ANXIOUSLY AWAITED

American engineers have designed and constructed a powerful motor, and the workshops for motors and airplanes are fully organized for the task ahead of them; but if these machines are not ready in time, provisions have been made in France and other Allied countries to place the necessary airplanes at the disposal of American aviators, so that they will be able to take part in the air battles in the early spring of this year.

On the whole western front, extending from the North Sea to Switzerland, the arrival of the American air fleet is anxiously awaited. This fleet must consist of a mighty battle squadron and a mighty bombing squadron as well.

The battle fleet is the decisive element in securing and maintaining supremacy in the air. But the Allies must also have a large number of pursuit squadrons, efficiently armed and piloted by daring aviators.

The American fleet of battle planes will enable the Allies to secure the indisputable mastery of the air.



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AN AIRMAN'S VIEW OF THE FAMOUS "CROSS OF CHARTRES" CATHEDRAL

A unique picture of one of the most treasured ecclesiastical structures in France. Across the upper half of the photograph may be seen a part of the framework of the airplane from which the picture was made. Situated 50 miles southwest of Paris, this magnificent Gothic pile has not felt the ravaging hand of the Hun.

It it necessary that this air fleet should come at the earliest date possible to take its place in the struggle. *The supremacy of the air for 1918 will be decided during the first months of the spring.* At that stage of the war it will be absolutely necessary that the Allies rule the air. As was the case in the cavalry battles of the First Empire, the supremacy wrested from the enemy in the first encounters will hold for many months, and subsequent small reinforcements ordered into the struggle will not be able to regain that supremacy. The American air fleet must be at the front early this spring and in great numbers. It will be there if American industry turns out products quickly and on a large scale. Time saved will save human lives. If two squadrons of American battle planes could have been at Dunkirk in September, 1917, the French Aviation Service would not have suffered the irreparable loss of Captain Guynemer.

Since 1915 French aviators have been making bombardment raids. The raid upon Karlsruhe, in 1915, made by 20 bombing planes, thoroughly terrified the Germans. In that attack more than 200 persons were killed or wounded, and for many months this reprisal stopped German bombing of French towns.

SHATTERING THE ENEMY'S MORALE BY AIR RAIDS

In 1917 bombardment of our defenseless towns by German planes began again. London and Dunkirk have suffered most.

Public opinion in America has been aroused against these bombardments. Reprisal bombardments have been suggested frequently and have been effected. Dresden and Frankfort have been visited by French planes. But the people of America must realize that it is more difficult for the Allies to carry out bombing expeditions than for the enemy. The same distance which will take the German machines over London and Paris will take the Allied machines over Belgian towns or French towns in the invaded territory, still quite far short of important German towns. It is thus clear that the problem of bombardment is a more difficult one for the Allies. And this is one reason why we should go at it with all our might. Only a person who has been in a town bombed by enemy planes, especially at night, can understand how panic-stricken the inhabitants become, and this increases the effect of the material destruction by shattering the morale of the people.

A systematic bombardment of open German cities, carried out relentlessly day and night without interruption, in answer to the bombardments the Germans have been carrying on for the last three years, in violation of all laws of warfare, would seriously affect the morale of the enemy.

The air campaign of 1918 will be decisive. A powerful bombing fleet, no less than a great battle fleet, is essential to success, and both should be ready for action in the spring.

By repeated raiding trips, day and night, this bombing fleet would contribute *immensely toward destroying the morale of the German people* and would hasten the end with an honorable peace.

HOW TIME CAN BE SAVED

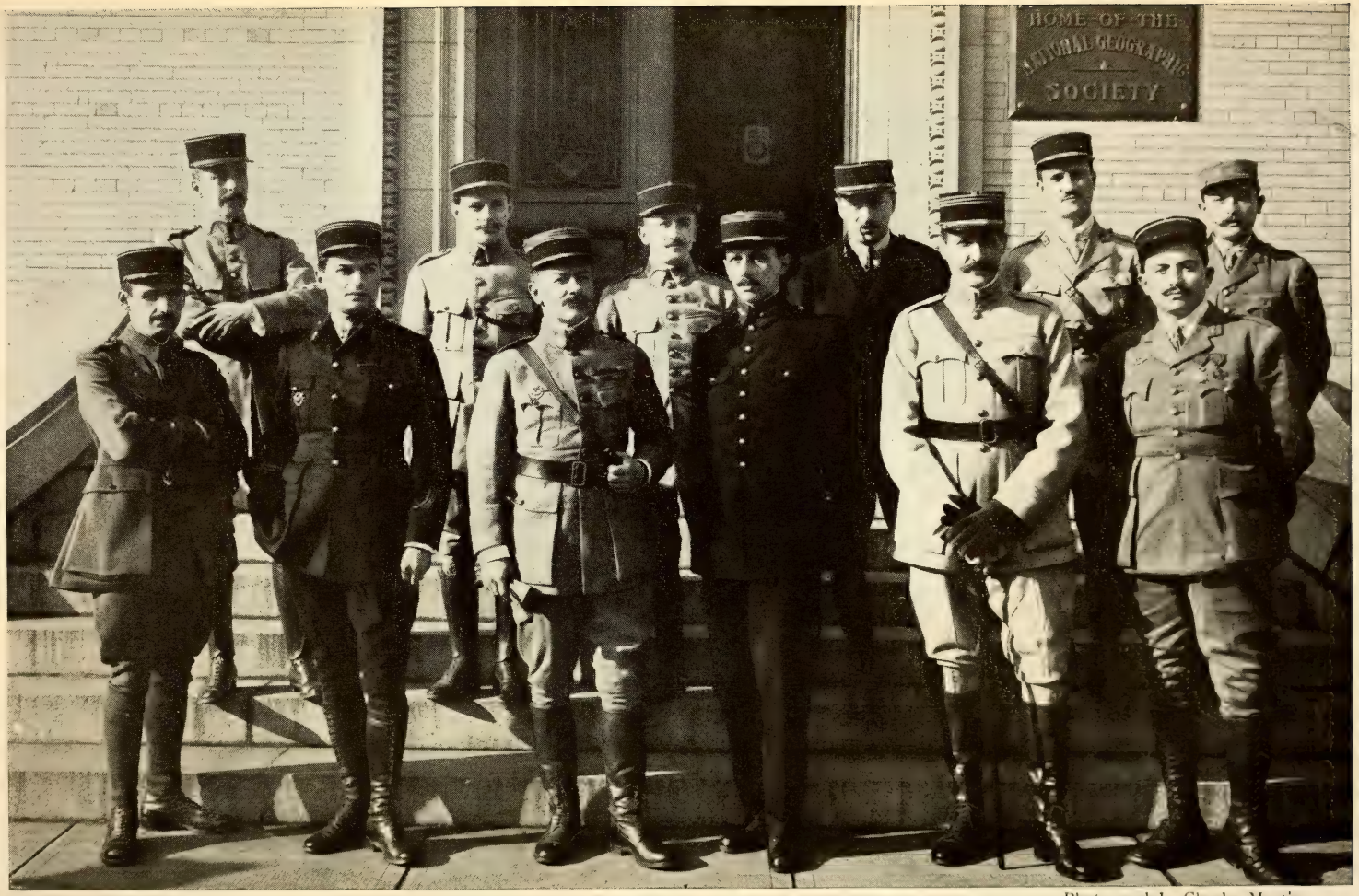
It is, therefore, necessary to put forth every effort to develop and speed up these two forces—a fleet of American battle planes and a fleet of American bombing planes. The thought of getting to France in time must stimulate the industrial population of America in the building of these air fleets, as well as the officers who have the enormous task of organizing this mighty fleet, of training the aviators, and arranging for the supplies.

How is it is possible to save time, and thereby to save human lives? This can be accomplished by spending money and applying to the creation of the American air fleet the wonderful industrial organization of the country, and, finally, by shipping the finished products fearlessly, by facing all risks.

AMERICAN AIRPLANES IN FRANCE WILL HASTEN END OF WAR

The sooner American planes appear on the French front, the sooner the war will end, the more lives will be spared.

In Europe great numbers of airplanes and engines of the type now used at the front are being built and will be used this spring.



Photograph by Charles Martin

MEMBERS OF THE FRENCH AVIATION MISSION TO AMERICA

Front row, reading from left to right: Lieutenant Espanet, Captain De Berroeta, Major Tulasne (Commandant), Captain Lepere, Captain De Guiche, and Lieutenant Marmier. Second row: Lieutenant Sergent, Lieutenant Lapachet, Lieutenant Vidalie, Lieutenant Tabuteau, Lieutenant Gueret.

In America the European types of airplanes and motors will be built, at first, to aid the English and French factories, in order that the Allies may have the largest possible number of battle planes at the earliest possible moment. Then the new airplanes, more powerful and better armed, will be built to be used during the summer of 1918.

The unlimited resources of American industry will make it possible to carry out these two building programs, first, to insure victory in the spring, which will soon be here; and, second, to provide for the future by building machines with the latest improvements.

The Allies are anxiously awaiting the aid of the American air fleet. If this fleet comes in time for the 1918 battle, it will be the deciding factor.

ACES OF THE AIR

By Captain Jacques De Sieyes

Of the French Aviation Service

AVIATION is a game—an amazing game, a game of adventure, of countless thrills, of soul-stirring excitement, a game in which courage, daring, resource, determination, skill, and intelligence achieve honor in life or, if the fates so decree, glory in death.

To the pleasure of accomplishing one's duty is added that of reaping immortal rewards—perhaps the reputation of a Guynemer, of a Nungesser, of an Heurteaux—men whose names the whole world repeats and acclaims.

The duty is glorious. If an aviator can accomplish his task by sacrificing himself for others, death can be faced with equanimity. And American history is sufficiently rich in glorious examples of sacrifice, of devotion, of abnegation, to prove that the sons of heroes of the past will be just as brave as their forefathers and just as ready to die, if need be, for a worthy cause.

Indeed, Americans have already proved their valor in the Lafayette Escadrille, some of whose members have fallen, but which has continued to increase in numbers until now it is the richest in pilots of any squadron in France. I lived in the Somme with this squadron. One of my friends, Captain Thenault, commanded it.

The Lafayette squadron is a squadron of pursuit, equipped with one-seater machines—swift, light, fast climbing, well armed, made to battle against enemy machines, to prevent their entering our lines and attacking our scouting machines while we are at work.

I had the good fortune to be in the aviation service at Verdun and on the Somme in 1916. These two operations, one defensive at first and the other offensive, resulted in the adoption by the aviation service of the organization now employed.

LIVING IN THE MIDST OF HEROES

I was in the pursuit branch of aviation, living in the midst of heroes who have glorified French flying. I have witnessed in the air acts of legendary courage; have heard on the ground reports of fights that thrilled us with admiration. There was an extraordinary fever among aviators, each one realizing the importance of his rôle and wanting to do more than his duty, and the aviation corps was flying in all weathers—in wind, in storm, in the midst of or below the clouds, at less than 200 meters.

The watch in the sky was never relaxed. From our aviation field, where the group of squadrons of pursuit was stationed, a squadron of 12 machines left every two hours, to replace another on the front. If reinforcements were asked, others left. Lastly, at each attack, the sky was swept by the entire group of nine squadrons, and each day brought new satisfaction. Each day brought also a fresh harvest of heroic actions, bloody

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A UNIT OF THE FRENCH AVIATION SERVICE WELCOMES AN AMERICAN WARSHIP UPON ITS ARRIVAL SOMEWHERE IN FOREIGN WATERS

sacrifices. Each day aviation reaped new honor and new glory.

Once it is the Sergeant de Terline who bravely enters a combat with five enemy airplanes, and bringing down one, puts the rest to flight. He pursues them, is wounded, his machine-gun jammed. In rage, unwilling to let go his prey, he precipitates his more rapid plane into the plane that injured him and drags it in flames with him as he rushes to his death.

Another time it is two of my comrades, pilots who protect me as I take photographs. An enemy machine comes to attack me. Both hear the same voice, the voice of Duty; the two comrades hurl themselves upon the enemy with such force, so straight, that they collide and fall in flames to the ground. The enemy plane, seeing the two dive upon him so fiercely, flees without disturbing me. I cannot recall without the greatest emotion the death of these two friends in saving me.

DARING ACHIEVEMENTS OF THE ACES OF AVIATION

Then again it is Nungesser, who climbs into his machine at 9 a. m., remains on the lines until 3 p. m., landing twice to take gasoline. In the meantime he has brought down an enemy balloon and two planes, one of which was getting the best of a British plane.

Or again it is Heurteaux who brings down a boche each fine day. I have heard that he was gravely wounded in Flanders a few weeks ago.

Then there are Thaw and Lufberry, the American "Aces," whose courage is a daily topic. And Tarascon, who, in spite of an artificial leg, brings down seven airplanes in three months.

And Captain Erard, an observer, who, in directing the firing of the cannons thus to protect the attacks of our infantry, flies so low above the lines that his plane constantly returns riddled with bullets. He ends finally by being hit, and falls, bloody, but smiling happily at death, in the midst of the infantrymen whom he has led to victory by sparing their lives.

Then there are five pursuit aviators who at each attack fire on the enemy, assembled for the counter-attack, and disperse them with heavy losses.

And Captain de Beauchamp, who bombards Essen at one time, Munich another time, passing from France to Italy. He has since fallen gloriously, a victim of a combat above Verdun.

Then there is Dorme, famous among us for his skill, who plays with German airplanes as with flies. But he loses one day at this dangerous game, and in a struggle with the enemy in superior numbers receives his death blow and falls in the German lines.

THE GREAT GUYNEMER

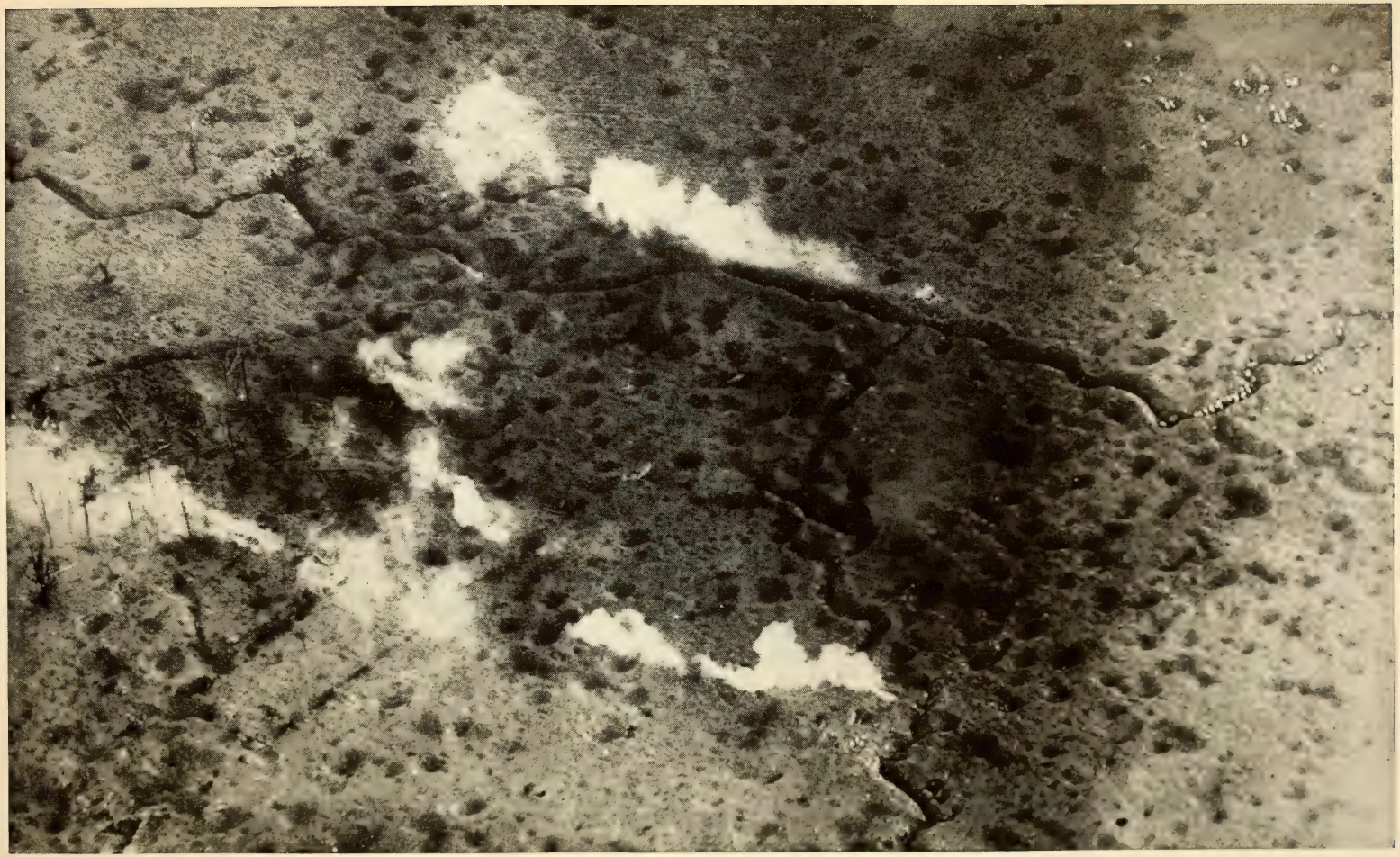
Fallen also is Guynemer, fallen from the sky of glory where he has written his deeds in letters of fire—Guynemer, whose name is on every lip—a pure jewel of valor and sacrifice.

"Fifty-four airplanes, 215 combats, 2 wounds."

That is his last citation before dying. It is quite sufficient to remind you of the whole story of that gallant air champion of liberty.

I have lived near him. I have known his intrepidity, his tenacity, his fascination. Duty of combat was for him a religion. He had an iron will. His presence alone so electrified his comrades that the squadron to which he belonged produced more aces than any other. He was upright as a sword, pure as a diamond, and utterly absorbed in the struggle which he carried on to the detriment of a constitution already frail. This mere child, who was yet more than a man, succeeded in bringing down three enemy airplanes in less than an hour. Chiefs and comrades spoke to him always with respect. He was of a finer essence than ourselves, inspired with a sacred fire which passed our understanding; convinced that he could not always be victorious, having already found himself several times in awkward positions, twice wounded, he kept at it furiously, never refusing combat, rather seeking it. Incapable of retreat, he fought in spite of everything, at any time, with any one, with any number, with 10, with 20, only abandoning the fight when wounded, without ammunition, or without gasoline.

Guynemer fell in the midst of 40 enemy airplanes, of which he had brought down one; one arm was broken, a ball in his



VIEW OF A FRENCH ATTACK FROM AN OBSERVATION AIRPLANE WHOSE RADIOTELEGRAPHY IS DIRECTING THE SUPPORTING ARTILLERY FIRE: ONE OF THE MOST REMARKABLE AËRIAL PHOTOGRAPHS OF THE WAR

In the upper right-hand corner may be seen the French infantrymen taking advantage of the protection offered by shell craters from enemy machine-gun fire. A little below may be seen the attackers in a trench. The white puffs of smoke indicate the activities of the French hand-grenade "trench-cleaners," whose duty it is to bomb the German dugouts after a successful advance. The soldiers belonging to the French infantry attacking corps wear white placards on their backs, so that they may be recognized readily by airmen whose duty it is to keep the artillerists posted so as to have the curtain of fire always a little in advance of their men.

head, and a smile on his lips. No words in any language can convey a just appreciation of his valor or his sacrifice.

In France they have given his mortal remains the place reserved for the great men whose names are the honor of our country—the Pantheon. At least, there they will rest when we shall have snatched away from the Huns the little churchyard of Poelscapelle, where they were buried respectfully.

But Guynemer is not out of the struggle for us. He is a star in the sky. Many stars will come to aviation, more numerous yet, lured by its gleam. Go over there—you shall see that star, and feel its lure, and desire to fly up to it. There is no child in France who does not lisp Guynemer's name; no boy who does not want to follow where he led; no soldier, no chief, who does not have before his eyes the example of that youth who overtopped them all. The path he traced is straight and true. He followed the way of honor.

THE AUTHOR'S OWN EXPERIENCE

I am reluctant to write of my own case, but I ask your permission to do so in order to show you what a fascination aviation has for one.

Officer by profession, I was interested in flying before the war, but only a few months before. Not being sufficiently trained when the war broke out, I had to go back to my infantry regiment on the eastern frontier.

On the 22d of September, 1914, both my arms were broken in a combat. As soon as I reached the hospital, I put in a request to enter the air service if possible. My request was refused; there was too great a need for infantry officers. So, when my arms were well again, I returned to my regiment at the front. In January, 1915, my foot was blown off by a shell; they cut off my leg and they cured me. They gave me an articulated leg. Not wanting to be discharged, I again put in a plea to join the aviation service, and after a great many formalities was allowed to become an observer. In a combat at Verdun our machine was riddled with bullets and was obliged to hobble back to our lines. A bullet had carried off two fingers of my right hand.

I joined my squadron again in the Somme after six months of illness in a hospital. I remained there five months, with the good fortune not to be wounded, happy to be able to serve once more. It was not the result of a wound, but of illness and weakness after nine operations in two years, that I was again sent away from the front.

In my assignment to duty in America I would like to think that I have not wasted my time here, and if I have been able to persuade some of my comrades in arms to become aviators my work will not have been in vain.

FLYING IN FRANCE

By Captain André de Berroeta

Of the French Aviation Service

THE SEVERAL thousand miles which separate the United States from the European battlefields render the conception of a modern battle very difficult for an American.

Moreover, such a rapid transformation in the instruments of war and in the methods of employing the different branches of the army has marked the period during which military operations have been maintained that even one who has witnessed the obstinate struggle throughout these three years has difficulty in following all the details of its mechanical evolution. The transformation has taken place more particularly on the French front, where the operations have reached an intensity unsurpassed elsewhere. The Marne, Verdun, the Somme, the Aisne have been so many

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FRENCH AIRPLANE WITH OBSERVERS FLYING OVER A NETWORK OF TRENCHES: PHOTOGRAPH TAKEN FROM A HIGHER AIRPLANE

Photograph-reading has become one of the highly specialized military professions of this war. The experienced observer, not the observer in the airplane, but the man who takes the camera products of the airman's flight and deciphers the changes in the enemy's trenches since the photograph made yesterday or last week, is invaluable at headquarters. To him a shadow may mean the installation of a new battery, a scarcely observable hair-like line the erection of formidable new barbed wire entanglements.

Photograph by International Film Service

AT THE THROTTLE ON BOARD A FRENCH AIR CRUISER: BELOW IS A DESTROYER UNDER WAY

Airships are more useful for sea-patrol work than they are over land, as the Germans have discovered to their cost. Near the coast they guard channels or detect mines and act in concert with warships against enemy U-boats. French dirigibles are fitted with at least two motors, strong and light, which give them great speed and their petrol supply insures them an extensive range of action.

diabolical furnaces in which were forged new implements of war and the powerful modern armaments.

The preparation, conduct, and results of an offensive military operation today bear but a faint resemblance to those of a battle at the opening of hostilities.

The extraordinarily effective application of aircraft to the uses of war has greatly accelerated this radical transformation. Today aviation reigns supreme over the field of battle, controlling the faintest pulsations of the great volcano.

The object of the present discussion is to trace the various phases of its evolution and, although it would be particularly bold to prophesy in the matter of military operations, to suggest the decisive influence for victory that the entrance of the American squadrons on the French front may have.

There are, at the present time, three branches of aviation which differ in the duties performed, in the machines used, and in the armament provided.

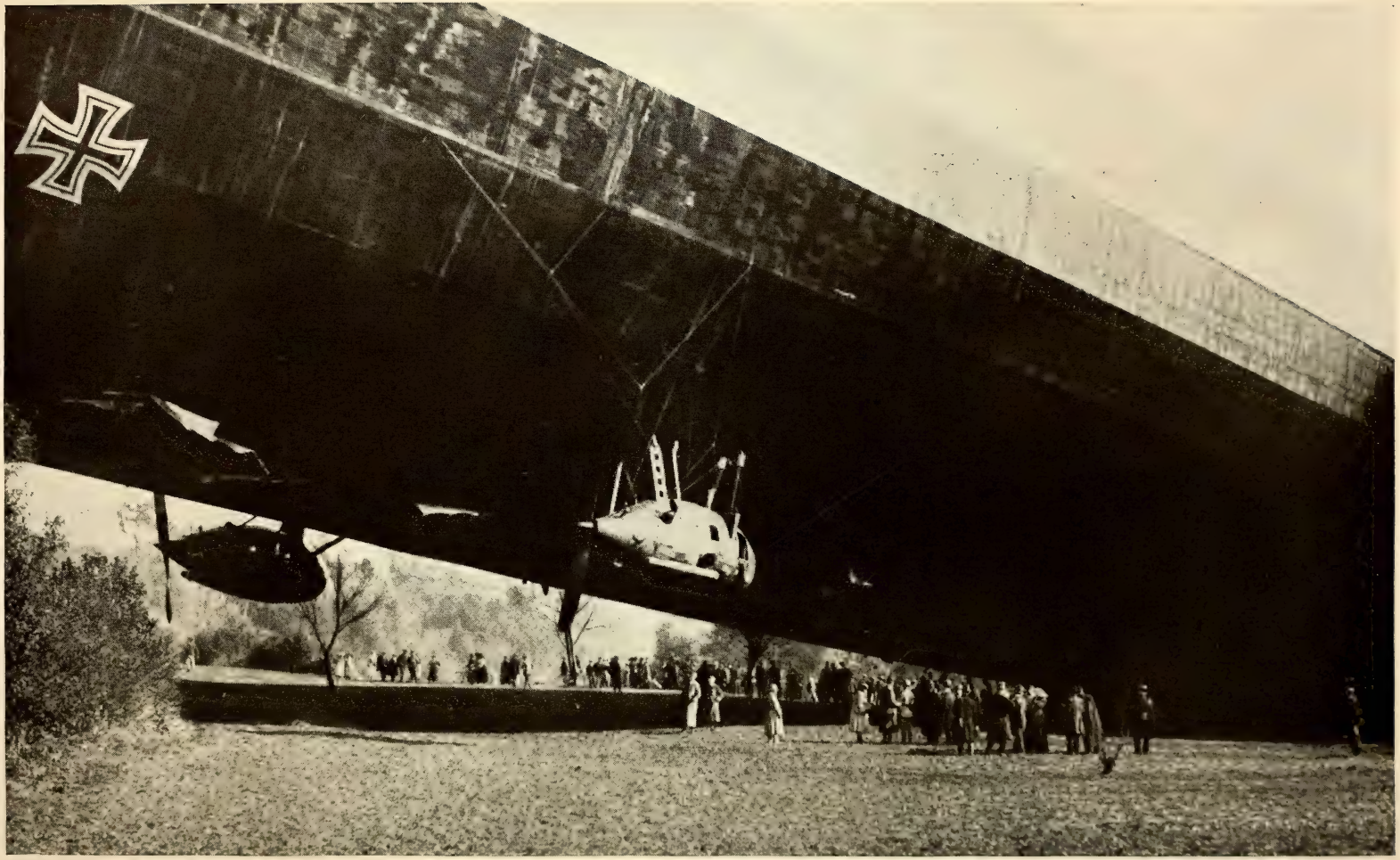
These are:

1. The Divisional or Reconnaissance Aviation, a valuable ally of the staff it serves, of the batteries whose firing it directs, of the infantry it assists in leading during the battle.

2. The Aviation of Combat, younger sister of the first and the most faithful ally she has for her protection from the aggressions of hostile airplaines. "Attack the boche, down him, or compel him to flee," is its clearly offensive motto.

3. The Aviation of Bombardment, hitherto chiefly employed in reprisals for the aërial raids of the enemy, but now called to a much greater and perhaps a decisive rôle.

Although essentially distinct, these three branches of aviation can only be effec-



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A GIANT VANDAL OF THE SKY WHOSE WINGS HAVE BEEN CLIPPED BY FRENCH AVIATORS

This mammoth Zeppelin, more than 472 feet long, was returning from its maiden voyage over London, where it had been murdering women and children. It was attacked by French airmen and brought to earth near Bourbonne les Bains. The two motors, with their propellers, suspended at the right and left of the body or hull of the airship, resemble nothing so much as two great ocarinas.

tively employed by the constant coördination of their efforts.

Let us consider the conditions and influences attending their birth and development and the rôles they are to play in the battles of tomorrow, in which your sons and brothers are to participate.

When the war was declared the chief strength of the French and German armies lay in the masses of their infantry, in the power of their artillery, and in the skill of their cavalry. However, it seemed the part of wisdom to put the few hundred airplanes we possessed at the service of the fighting forces, in order to facilitate the success of their undertakings. The offensive strength of both the French and German squadrons was very small in comparison with the millions of combatants ready to clash with each other, supported by the fire of several thousand cannon.

But these airplanes possessed the power of exploring the field of battle to an extent far beyond that of the cavalry, for which this delicate and dangerous duty had hitherto been reserved. To them, accordingly, from the beginning of the war, was intrusted the observation of the movements of the hostile armies.

During the whole period, termed the "War of Movement," that is to say, until the battle of the Marne, the French commanders were kept promptly informed of the movements of the German forces, thanks to the daring reconnaissances of our pilots, who, accompanied by staff officers, made flights far within the lines of the enemy and at a low altitude, in the rear of the hostile forces. The Aviation of Reconnaissance was thus created during the first days of hostilities.

AIR SERVICE DEVELOPMENT

The number of aircraft in use was so small that a hostile airplane was rarely encountered in the course of these reconnoitering expeditions. If adversaries did chance to meet, all the pilots could do was to shake their fists at each other or discharge their revolvers without the slightest chance of hitting. It was, however, from these gestures that aërial combat took its birth, the history of which will remain as one of the most brilliant epics of the present war.

Taking advantage of their excursions within the lines of the enemy, the pilots carried with them a few artillery projectiles which they dropped on hostile assemblages, camps, or columns. Such was the beginning of aërial bombardment, which, at that epoch, was left to the initiative of each pilot. The bombs were thrown without aiming, over the edge of the cockpit, and it was counted a lucky shot when the projectile hit the intended target. Moreover, the airplanes of this period were not capable of carrying heavy loads; so that the pilots, as a rule, had to be satisfied with small steel arrows, which they dropped upon the enemy wherever they found them assembled in large groups.

This is, in brief, the history of aviation. It is evident that the general law governing the development of all technic must apply to the development of aviation, and that the aviators must specialize as observers, as fighters, and as bomb-droppers. If this organization had been effected in time of peace, it would doubtless on the outbreak of war have been immediately introduced at the front in all its forms; but, as I have told you, it is the experience of war that has made aviation what it is today, and only on the field of battle that it has been possible to develop the organization of military aëronautics.

There was no time to lose in France, nor in Germany. Before all else the aviation of reconnaissance was organized. The Marne had exhausted the contending armies. The ammunition had been recklessly expended during this decisive battle, which saved the world from the German yoke. Each army clung to its positions, while strengthening them with works of fortification.

Trenches, dugouts, block-houses, and barbed-wire entanglements—everything that pertained to stationary warfare made its appearance, transforming the field of battle in a few weeks into an immense work yard, where every one disappeared behind natural defenses or improvised earthworks. Several million men buried themselves like moles.

The artillery, profiting by this respite, was able to find positions concealed from the view of hostile observers. Soon the

Photograph by Paul Thompson

THE TWISTED, TANGLED REMAINS OF THE L-45 A FEW MOMENTS AFTER IT WAS FORCED TO DESCEND AT MISON, IN SOUTHERN FRANCE

This Zeppelin was destroyed by one of its own navigators after it had been brought to the ground. The 17 members of the crew were made prisoners, but not before incendiary bullets from a German revolver had accomplished the work of demolition.

field of battle gave to every one the terrible sensation of being spied upon by an adversary who inflicted blows from an invisible source.

ARTILLERISTS APPEALED TO AVIATORS

Artillery ammunition being particularly scarce, it was important to fire only on reliable information and at objectives known to be actually occupied by the enemy. Under these conditions the artillery quite naturally appealed to the aviators, who, on account of the immobility of the armies, were now less absorbed in distant reconnoitering expeditions.

Our brave pilots, who during the beginning of hostilities had been carrying the staff officers, now placed themselves at the disposal of the artillery officers, who set out to discover the hostile objectives by watching the regions of battery emplacements. The observation officer recorded on his map the position of the batteries that had been surprised in action during the course of his flight. The landing was made on some field in the immediate vicinity of the French batteries, which, being informed in regard to the position of the enemy, opened fire in most cases according to the map—that is to say, without observation of the hits.

But it would have resulted in a far greater efficiency had the aviator, after discovering the objective, remained in the air to observe the firing and report to the battery the errors of its shots. This is the problem of adjusting battery fire by aërial observation (spotting), to the solution of which the artillery officers and aviators are assiduously devoting themselves.

One of the first methods had for its basis the dropping of signal lights. Then the aviator made use of certain evolutions of his machine, indulging in performances almost acrobatic to announce the results of the shots. This crude method was soon supplemented by the use of radiotelegraphy. France enjoys the distinction of having been the first to make use of radiotelegraphy on its airplanes.

The enthusiasm evoked by the success of these first spottings was only surpassed by the chagrin of our enemies, who were subjected to an accurate and murderous fire from our batteries, while an airplane with the tricolored cockade was performing graceful evolutions over their heads. It is only fair to add that within two months after our first trials the Germans had furnished their airplanes with radio apparatus, so that we were able to verify, at our own expense, the advantages of this new method of directing artillery fire.

But for every new weapon there is a corresponding defense, and for protection against the incursions of hostile airplanes they are attacked by airplanes armed with machine-guns, are fired upon from the ground with special guns, and certain curious stratagems are employed which may be briefly described.

FAKE BATTERIES TO DECEIVE SCOUT PLANES

For the purpose of deceiving scout planes in quest of targets, false battery emplacements have been prepared and provided with wooden guns. Seen from above 4,500 feet, their appearance is the same as that of the real batteries of which they are a faithful copy. To complete the illusion, as soon as a hostile plane passes through the lines, the real batteries stop firing, while the false ones are illuminated by suitable artificial flashes, giving the appearance of a battery in action. This deception is often very difficult to detect. Both French and German gunners have often fired at wooden batteries, while an airplane perseveringly spotted the firing.

These false batteries and the artificial activity given them in the eyes of the aviators could deceive only for a time, because the aviators were not satisfied with simply observing them, but took photographs of the field and were thus enabled to study in detail, far from the excitement of the front lines, the changes which the defensive works of the enemy underwent from week to week.

By a careful study of these pictures they learned to interpret them and thus gave birth to a new branch of military art, that of the interpretation of aërial photographs. Without entering into the details of this fruitful and fascinating study, you can readily understand that by means of lenses with a sufficiently long focus an accurate image of the field can be obtained, and that certain indications on the photographs distinguish the real batteries from the fictitious.

Moreover, the comparison of successive photographs of a given region permits the detection, with practical certainty, of the intentions of the enemy. If he is about to attack, the photographs reveal the bringing up of new pieces of artillery, of ammunition, and even of troops, whose movements widen the trails; they show the creation of new roads, the building of field hospitals, and the enlarging of railway stations near the attacking front.

If, on the contrary, the enemy is about to withdraw, the photographs show the new fortified positions he expects to hold at the time of his retreat and the destruction of railroads and highways, which are the prelude of a retirement. It has truly been said that each adversary inscribes upon the field his plan of operations. It is therefore to the reading of this inscription, as one of their permanent and fundamental tasks, that the scout aviators are called.

In a word, the scout aviators who are at the height of their efficiency never fail to snatch from the enemy the secret of his operations. They no longer permit surprise attacks, which are the most to be feared of all the hazards of war.

Furthermore, they are not limited to the execution of this difficult program. Not content with unveiling the plans of the enemy by the thoroughness of their investigations, and with assisting the artillery in adjusting the firing on the trenches, fortifications, and batteries of the enemy, they render their most effective service during the progress of the attack itself, which they direct and control while allowing it a logical development.

THE FORMIDABLE TASK OF THE SCOUT PLANES

I shall try to give you a very brief glimpse of the formidable task performed by the scout planes during the preparatory phase of a battle and during the critical phase of the battle itself. The time has passed when one could make an improvised attack upon the enemy, relying simply upon superior numbers and the morale of the attacking troops to gain the victory.

To search out, in all their details, the defensive works of the enemy (barbed-wire entanglements, trenches, block-houses), the position of all his batteries; to locate the trails, railways, munition and supply depots, and headquarters of the commanders; such is the work to be performed by the scout planes before every offensive operation.

To direct the firing of all the artillery, whose task is to destroy the barbed-wire entanglements and the trenches; to bombard the batteries and destroy the larger part of them, to set on fire the munition depots within its range, to prevent or render perilous any passing along the roads and railways, to delay traffic in the supporting railway stations, to control the destruction of objectives and the efficacy of long-range firing; such are the principal tasks of the scout planes during the preparatory period of an attack.

Moreover, they assume the enormous responsibility of the faithful execution of this program, which is carried out entirely through the intermediation of their eyes.

VITAL REPORTS OF BATTLE'S PROGRESS SENT BY RADIO

Finally, on the day of attack, it is they who, flying at a low altitude over the assaulting waves of the infantry, signal its progress to the superior command; it is they who discover the active batteries and reduce them to silence by causing them to come under destructive fire; it is they who cause the dispersion of wagon trains and troop columns venturing along the roads and trains near the battlefield; it is they who watch for the possible launching of a counter-attack, always to be feared, and which they must announce at the right moment to the infantry and to the commander in charge.

Thanks to the promptness of their reports, sent by radio, the commander is enabled to make his authority felt during the progress of the operation. When, in the midst of the hazards of battle, the energies of the combatants become scattered, causing confusion and disorder, the scout planes, by the accuracy of their reports, permit the harmonizing and coördinating of effort necessary to the final victory.

To describe the airplanes used in scouting, the details of their armament and the devices with which they are equipped,

© International Film Service

FUR-MUFFLERED AND GLOVED, A FRENCH AËRONAUT PREPARED FOR A LONG STAY IN THE AIR TO OBSERVE THE ENEMY'S OPERATIONS

This photograph was made from a new type of observation balloon which carries two baskets. The second basket, accommodating the photographer, hangs very near the one shown in the picture.

Photograph from French Aviation Mission

THE FRENCH VILLAGE OF VARENNES FROM A HEIGHT OF 7,800 FEET

The airplane from which this beautiful bird's-eye photograph was made was flying above the clouds, which veil a portion of the town, only a few miles from Verdun. The observer's record (at the top of the picture) shows that it was made at 10:45 on the morning of May 24, 1917, at an elevation of 2,400 meters.

would carry me beyond the limits of my space. Evidently it is the observer who must have charge of the mission of reconnaissance, of photography, of artillery adjustment, or of infantry communications; but he is greatly assisted by the pilot, whose skill and decision contribute in no small measure to the successful accomplishment of the aërial task.

This, then, is a brief sketch of the immense task of the scout aviators. You can understand why both France and Germany first organized this class, so indispensable for conducting land operations, offensive as well as defensive.

Do not think that the task of the second kind of aviation, *that of combat,* is any less important or any easier. I said that the aviation of combat was the younger sister of reconnaissance aviation and her faithful ally. This is true, for she was born after the latter had attained considerable importance, and grew up at her side, her principal mission being the protection of her elder sister from the attacks of the enemy.

THE TACTICS OF FIGHTING PLANES

I will explain in a few words the methods of the pursuit or fighting planes and the special duties which the aviators of the pursuit squadrons have to perform. To understand the tactics of our machines you must be acquainted with the methods of the enemy—that is, with the formation adopted by the Germans for the execution of their work.

In normal times the German planes are disposed in three stories, the most elevated being also the farthest from the front.

1. The spotting and infantry planes, at a height of about 3,500 feet and at least half a mile from the front. These are protected by:

2. A defense (barrage) of two-seaters, at a height of about 9,000 feet and from two to three miles within their lines.

3. Lastly by the "Aces," who, utilizing the best single-seat and a few two-seat planes, hold themselves at a height of about 12,000 feet, between three and four miles back of their lines.

In periods of crisis, when an attack is believed imminent, or when photographs are to be taken within our lines, the Germans launch large groups of machines over the affected points. In particular, reconnaissance missions are executed at heights of 13,500 to 15,500 feet.

To this rigid and defensive arrangement we oppose a war of *movement* by the employment of *offensive cruisers,* terraced like the enemy's machines, which it is their duty to attack.

Our fighting machines are at present swift single-seaters, flying from 125 to 140 miles per hour, each armed with one or two machine-guns, rigidly fastened to the airplane and capable of shooting only in the direction of the axis of the machine, not pivoted like the guns on war vessels.

The pilot must therefore fly straight at the enemy in order to be able to fire at him. He must be skillful in aiming and steering at the same time, so that at the moment for firing the hostile plane will be in the sighting line of his machine-gun. I leave you to imagine the skill required to attain this result, when one attacks an enemy flying at an average velocity of 125 miles per hour, with his own machine going at an equal or greater speed.

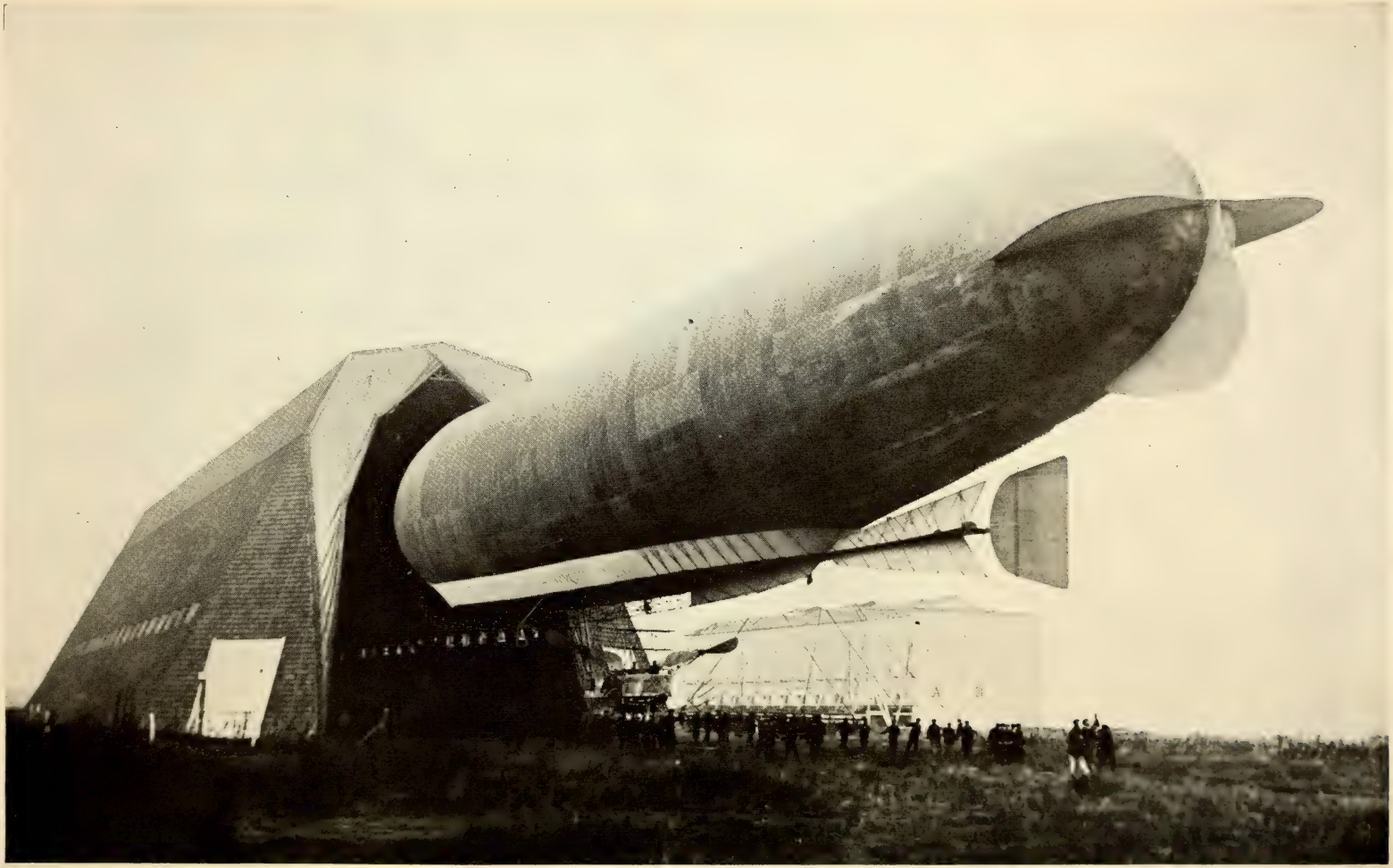
THE VARIOUS MODES OF ATTACK

The following are the principal cases of attack for fighting planes:

1. *The attack by an isolated single-seater on a single-seater, likewise isolated.*—This is the easiest case. Above all, the effect of surprise is sought, either by taking advantage of fog, or by getting between the sun and the adversary, or getting vertically over him, where he cannot see you. Having made a successful approach, you must get into a good firing position—a short distance below and behind your adversary, while avoiding the wind from his propeller.

To accomplish this, each pilot uses his individual methods, which vary in each particular case. One of the common maneuvers consists in diving from a sufficient distance to about 300 feet behind the adversary, dropping about 60 feet lower and coming into position for firing by an upward dash.

If the enemy has suspected nothing, it is "assassination."



Photograph by Central News Photo Service

A FRENCH DIRIGIBLE ENTERING ITS HANGAR

Except in rare instances, and then only in reprisal for German attacks upon unfortified cities like London, the French and British have not indulged in airship raids upon enemy population centers behind the battle line. But when they have launched their bombs, as at Dusseldorf, the damage inflicted has been enormous.

If he has seen you, he either flees or accepts combat.

If he flees, fire after him.

If he accepts battle, each adversary maneuvers to keep the upper position in the air in order to be able to drop suddenly behind and below the other. It is a question of skill and quickness of eye. After a few passes, one of the two gets the upper hand. When the boche feels himself beaten, he usually tries to escape by diving. If he dives in a straight line, keep firing at him, as at a target. If he zigzags, you must keep close behind him, tacking every time he does. His only salvation then lies in the tail-spin or in turning over on the wing.

Often the single-seaters prefer to operate in pairs. In this case they either both attack at the same time, in order to divide the attention of the German; or one attacks above, while the other guards the rear of the attacking machine.

2. *Attack on a two-seater by a single-seater.* To effect a surprise is always a first consideration. The importance of the attacking position is greatly increased by the presence, on the hostile plane, of a machine-gun operated by the observer and often covering a large field. Before all, one must never get into the three-quarters position—rear, below, nor especially above—for he would certainly receive some bullets.

The best position is either in front and a little below, or *under the tail.* If he is coming from three-quarters front, on the same level, he opens fire at about ninety feet, and if the boche veers to give the field to his observer, he takes advantage of this move to get under his tail.

3. *Attack on a hostile group by a single-seater.*—The object of the first maneuver is to isolate one of the airplanes, so as to attack it separately. He drops into the midst of the group while keeping a little above and firing at all his adversaries, so as to force them to maneuver. It is seldom that one of the enemy, in his excitement, does not detach himself by turning to the right, while the others turn to the left. It is upon the former that our fighter precipitates himself.

4. *Battle of a group of single-seaters against a hostile group.*—The group, consisting of four or five machines, holds itself at a high altitude. The V formation of flying is adopted. The leader flies at the point of the V, the others being terraced behind him. The planes leave about 450 feet between them, in terraces, the leader being the lowest.

The Germans fly likewise in V formation or single file, in steps; but, with them, the last plane is the lowest, the leader being the highest.

This results in the following form of attack. The French leader announces that he is about to attack, by balancing twice, and dives at the last German plane, which is the lowest. The other boches make a half-turn and fall upon him. The remaining Frenchmen then attack them, with all the trumps in their own hands, the one uppermost in the air having the initial advantage.

DESTROYING GERMAN KITE BALLOONS

The other possible missions of the fighting squadrons include:

The destruction of the drachens (kite balloons), which completes the fight against hostile aircraft for the purpose of blinding the enemy. This mission, indispensable in the course of an important operation, is executed at the request of the commander interested.

The method usually employed is the following: An airplane is designated for each drachen. It is protected by a second airplane, on account of the single-seater defending the balloon. Then our airplane dives in such a way as to make the last 900 feet at an angle of 45 degrees. It approaches the drachen facing the wind, so that the latter will present its maximum of surface, while protecting him from the machine-gun in the basket. At a distance of 300 feet he fires a volley of incendiary bullets. This mode of attack is often successful. If not, the Germans pull the balloon to the ground. In either case the object is attained.

To blind the adversary by destroying his aircraft is the fundamental result sought by the fighting group; but it can also assist in the battle by getting information and by attacking the ground forces.

Having very swift machines at their disposal and being able to open the way

Photograph from Pictorial Press, French Official

LOOKING UP ALONG A SHIP'S MAST AT A CAPTIVE OBSERVATION BALLOON POSTED AS A LOOKOUT FOR ENEMY UNDERSEA BOATS

by main force, the fighting aviators are required to execute *long-range reconnaissances.* But it is especially during their cruises within the hostile lines that the single-seater pilots gather useful information concerning the activities of the enemy in the air and on the ground. By making general the use of automatic photograph cameras, a rich harvest of valuable information will be assured.

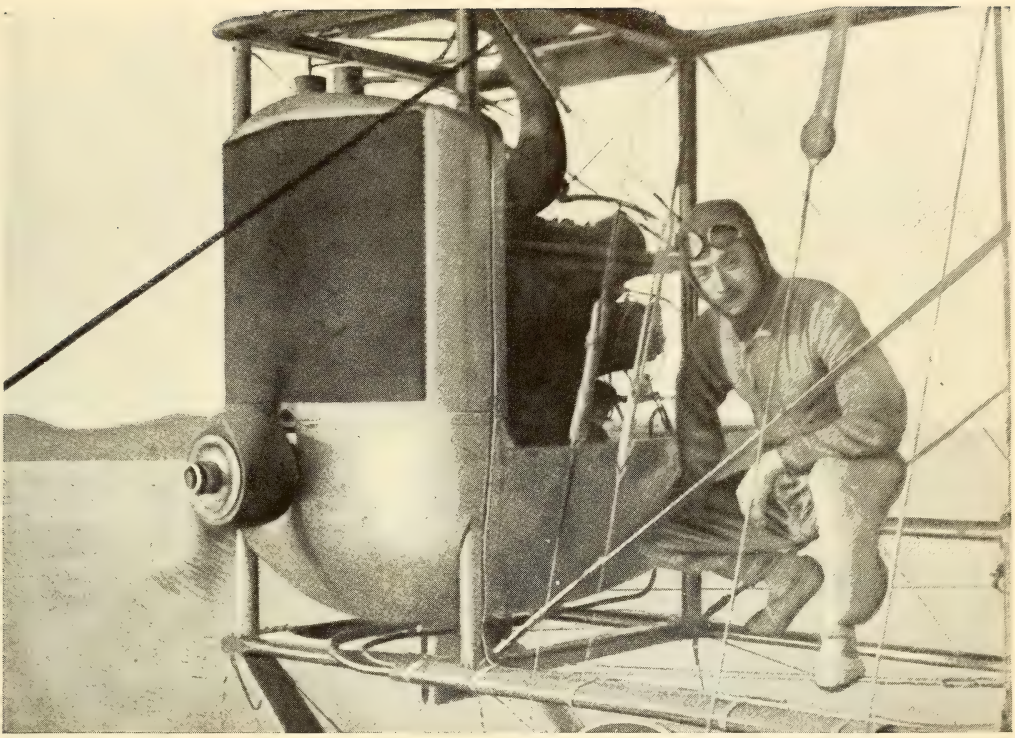
HOW TROOPS CAN BE ATTACKED BY AIRPLANES

The attacking of ground forces is a matter of individual prowess rather than a productive operation. Troops can only be attacked in the open field and from a low altitude with machine-guns, bombs, and darts.

Such, then, are the conditions for the employment of the fighting squadrons.

It remains for me to tell you of *aërial bombardment,* which is, perhaps, destined to be one of the most effective forms of aviation when organized on a large enough scale.

But before all, let us consider what should be bombarded. You well know the revolting conduct of our adversaries, who, in spite of all laws of civilized warfare, initiated the practice of bombarding open cities, hoping by repeated murders



Photograph by International Film Service

A MECHANIC REPAIRING ONE MOTOR WHILE THE FRENCH AIRSHIP PROCEEDS UNDER THE POWER OF ITS TWIN MOTOR ON THE OPPOSITE SIDE

Note the slight blur in the photograph at the end of the shaft at the left, indicating that the propeller blade is revolving rapidly

of helpless children, women, and old men to cause panic among the civilian population of France and England.

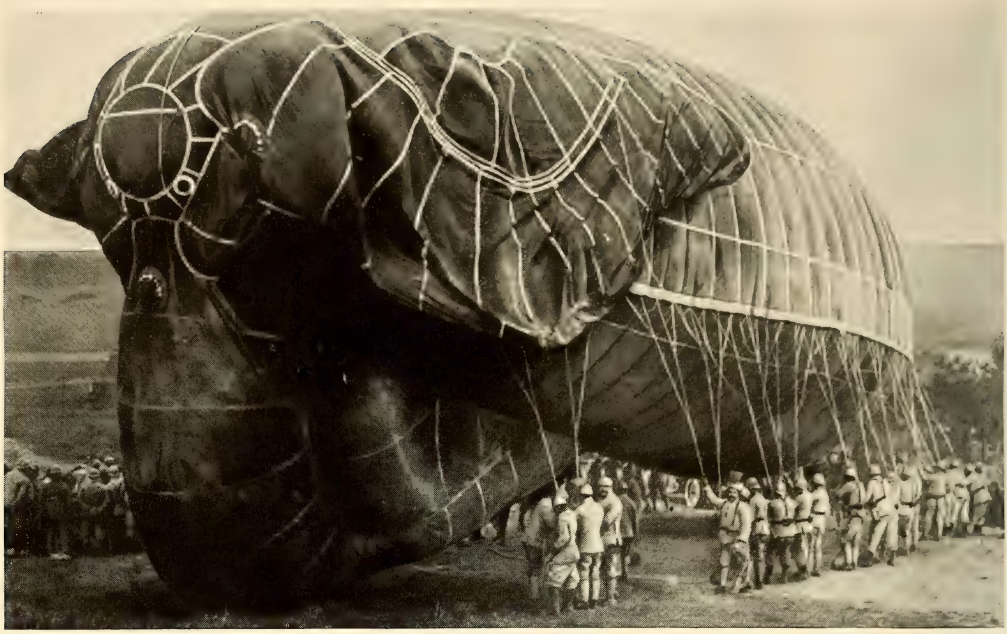
From the purely military point of view, these bombardments are of no value, so long as they attack only non-combatants and do not injure in any way the fighting forces of the enemy. On the day of a decisive battle, of what use is it to have mutilated the civilian population of the enemy, which takes no effective part in the fighting?

It follows, therefore, that this practice should be absolutely forbidden in war. Furthermore, let it be said that France and England have made raids on open cities only in reprisal for German raids on their cities. Among the most famous of these reprisal raids is that on Karlsruhe, in June, 1915—a great success, but with the loss of two airplanes. Then again on the same city in August, 1916, when considerable destruction was caused and the moral effects were far-reaching. This expedition caused the boches to reflect and held them in restraint for fear of further reprisals.

But, I repeat, we have not made a general practice of these raids, first, because they have no definite military object, and also because it is more difficult for us to reach the German cities than it is for them to fly over the French and English cities. In fact, the Germans set out from French provinces or from the borders of Belgium, which they have invaded. The distance traversed by their machines when they go to London, for example, would only carry a French or English machine over Belgium or our invaded provinces of Alsace and Lorraine.

In other words, the German cities are much farther from our lines than the French and English cities are from the enemy lines, since we have to cross Belgium or our invaded provinces before reaching the heart of Germany.

But, apart from these expeditions, are there not purely military objectives that



© Paul Thompson

FRENCH OBSERVATION BALLOON, OR "ELEPHANT"

powerfully equipped bombarding planes can reach and destroy?

ATTACKING THE ENEMY'S MOST VULNERABLE POSITION

It is the problem of the employment of bombarding or bomb-dropping planes, in coöperation with the other branches of the army, that we are about to consider.

In general, it may be assumed that all objectives on the battlefield which are beyond the range of the guns may be effectively bombarded by airplanes, provided these objectives are large enough to be easily hit. It must be remembered that bomb-dropping by airplanes, although well conducted with the most accurate devices for sighting and launching, never attains the precision of artillery fire. It would therefore be useless to attempt the destruction of small objectives.

Without undertaking the description of the battlefield itself, with its first and second line trenches continually exposed to the fire of the enemy, I wish to mention the principal organizations, which are located immediately back of this fighting zone of about eight miles. In this region of comparative safety the troops are assembled for an attack.

There one finds the army supply stations, artillery depots, ammunition depots; also the airplane landing fields, with their hangars, their machines, their rolling stock. Lastly, it is in this region that the soldiers are located to rest after their sojourn in the trenches, and where they can profit by the relative quiet to obtain the necessary relaxation for their nerves after the rude shocks of battle.

This zone is reached only by an occasional very rare shot from special long-range guns, which are not often used on account of the great expense and the great difficulty and long delays involved in moving and mounting them on new foundations. It follows, therefore, that the rear of the battlefield is *densely occupied,* very *vulnerable,* and *practically unmolested.*

These are the three essential conditions for the profitable employment of bomb-dropping airplanes, and these are the real military reasons why our fighting squadrons have expended their energies in operations over the rear lines of the enemy rather than in distant raids of doubtful military value. In regard to this question of the choice of objectives, I think you will agree with me that the excitement caused by the long-distance raids hardly compensates for the slight gain.

A FRENCH "SAUSAGE" BALLOON READY FOR AN OBSERVATION ASCENT

The tumor-like protuberance at the lower end of the gas bag acts as a stabilizer. The end under the bag is open, and through this simple mechanism the balloon is kept pointed into the wind.

However exciting it may be to *read* of such exhibitions of prowess, far from the fray, it must not be forgotten that it is only by striking the enemy in a vital part that any important weakening of his power can be effected.

Moreover, the ravages resulting from repeated bombardments of the rear lines are considerable, both from the material and moral points of view. A single lucky shot can blow up an ammunition depot containing tens of thousands of shells and effectively weaken the offensive power of the artillery.

SHATTERING THE ENEMY'S MORALE

A bomb falling into the midst of an encampment of troops at rest throws confusion among the men whose nerves, shattered by the shocks of battle, are commencing to recuperate. I leave you to judge of what value are troops who, harassed by the enemy even in their rest camps, are obliged to return to the front without having been able to get their needed rest.

From this point of view the damage done the enemy by bombarding his aviation fields may likewise be very great. The machines of several air squadrons are often assembled on one field, offering a very vulnerable target to the shots of the enemy.

During the battles of Verdun, the Somme, and the Aisne our bomb-dropping squadrons were daily employed, in conjunction with the other branches, in preparing for the success of our offensives by harassing the vulnerable parts of the enemy's rear lines. Several ammunition depots were destroyed and the ravages caused in connection with the transportation of troops, notably at the railway station of St. Quentin, will be famous in the annals of the war.

A choice must be made between the two methods. The French and English have developed the bombardment of purely military objectives, while our enemies have devoted their energies to dropping bombs on cities.

It goes without saying, that every ef-

A FRENCH GAS ATTACK BEING LAUNCHED AGAINST THE GERMANS FROM A POSITION MIDWAY BETWEEN THE FIRST AND SECOND LINE TRENCHES: PHOTOGRAPHED FROM A SCOUT AIRPLANE

fort is made to carry the maximum load of bombs. But it is evident that this is possible only at the expense of the speed of the airplane and especially of the quantity of gasoline and oil it can carry, thereby limiting its radius of action.

Accordingly, two very different types of machines have been invented—one very swift, able to fly at a speed of over 110 miles per hour, but carrying only 700 pounds of bombs (Breguet type); the other very slow, since it can make only 80 miles an hour, but able to carry 4,400 pounds of projectiles (Caproni type).

The first type is used day and night on the French and English fronts, where the enemy has his most powerful planes.

AIRPLANES WHICH ARE USED AT NIGHT ONLY

The airplanes of the second type, because of their low speed, can only be used over the front lines by night. They would be brought down, without fail, should they venture within the enemy lines by day, where they would only be the playthings of the swift hostile battle planes.

In regard to what may be expected from the entrance into line of American air squadrons, this spring, it may be said that although the Allies have always held the aërial superiority over their enemies, at the cost of very heavy sacrifices, the advantage in our favor has never been great enough for us to risk a decisive battle, that would forever give us the absolute mastery of the air. Whole squadrons have been beaten down, but the destruction of the enemy's air fleet has not yet been accomplished, owing to the lack of sufficiently powerful means.

This is not, however, an impossible conception, and in the future, when America's air forces arrive to reinforce those of her allies, it is possible that the annihilation of the enemy's fleet may be undertaken, after several days of sustained battle at the outset.

In case our forces prove the stronger, the enemy will have no other alternative, to prevent the loss of his air squadrons, than to refuse battle by not flying; but when our bombing squadrons intervene with an effect so deadly as to compel his fighting planes to give battle, he will then bring on the struggle in which the German air fleet must succumb.

I do not pretend to foretell the future. I can simply tell you this. The decisive air battle has not yet been fought, although gigantic land battles have taken place. America will, I hope, have the honor of fighting this battle at the side of her allies, and it is probable that the road to victory will then be opened by way of the air.

TALES OF THE BRITISH AIR SERVICE

By Major William A. Bishop, V. C., D. S. O., M. C.

Major Bishop, the premier ace of Great Britain's Royal Flying Corps, is the only living person who has won the three distinctions of the Victoria Cross, the Distinguished Service Order (twice bestowed), and the Military Cross. Although only 23 years of age at the present time, he had been a member of the Canadian military establishment for three years prior to the outbreak of the world war, and became an aviator shortly after reaching France with the first expeditionary forces from the Dominion. During the past three years he has brought down 47 German machines in 110 air battles. Captain Albert Ball, several of whose exploits Major Bishop describes in the accompanying article, was only 19 years of age when killed, yet he long held the record among British aviators, the official count of machines destroyed by him being 43. At the time of Captain Ball's death Major Bishop had destroyed 15 planes. The latter rapidly took a commanding position in the records and a few months ago surpassed the count of his compatriot who had fallen. Major Bishop now not only outranks in air achievements every other member of the Royal Flying Corps, but has held the record for all the Allied armies since the death of Captain Guynemer, of the French Aviation Service.

SOME of the exploits of the late Captain Ball, V. C., were most exciting. He was especially noted for getting himself into the tightest corners and then, in an instant, turning defeat into victory and coming out of the fight victorious.

Upon one occasion in the early part of his career as a fighter he had gone some twenty miles across the enemy lines, vainly looking for some one to fight with. Finally he saw two enemy machines flying together. Without hesitation he flew straight at these two and engaged them in a fight which lasted over ten minutes, at the end of which time he found that he had run out of ammunition. The two enemy machines had also had enough of it by now and seized their first opportunity to escape, diving down to the ground.

Ball was much disgusted at this and emptied six rounds from his revolver at the two diving machines. He then seized a piece of paper and a pencil which he had with him and wrote out a challenge for the same two machines to meet him at the same spot the next day.

At the appointed time Ball turned up on the spot and a few minutes later the same two enemy machines approached him from the east. He flew toward them to engage in a fight, but at that moment three more of the enemy came down from the sky and attacked him. It was a carefully laid trap and he had fallen into it without even suspecting that there was one.

The three enemy machines that had attacked him from behind were of the latest fighting type and were all flown by expert men.

At every turn Ball, who was underneath and was thus at a slight disadvantage, found himself outmaneuvered. Turn and twist as he would, he always found one of the enemy on top of him and another just ready to catch him if he turned the other way. Several times bullets passed within inches of him. Finally, deciding to escape, he realized that he must do something extraordinary; so he dived toward the ground and, picking out a large field, glided into it and landed.

The three enemy machines at once suspected that he had been shot and forced to land, and they all glided down and landed, either in the same field with him or the adjoining one. Then, jumping out of their machines, they ran over to Captain Ball. However, Ball, who had carefully foreseen exactly what would happen, had kept his engine running slowly while he was on the ground, and the moment he

Photograph from Press Illustrating Service, Inc.

BIRD'S-EYE VIEW OF SALONIKI FROM AN AËROPLANE

Perhaps no other city in the world is so "fed up" on airplanes as Saloniki, the Allies' base in the Balkans. The enemy fliers usually make their reconnaissance about the noon hour, flying from behind their lines a hundred miles distant. The Teutons endeavor to learn of important contemplated moves on the part of the Allies by keeping tab on the arrival of any considerable number of ships in the Saloniki harbor.

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METHODS OF TRANSPORTATION, ANCIENT AND MODERN: EAST AND WEST MEET

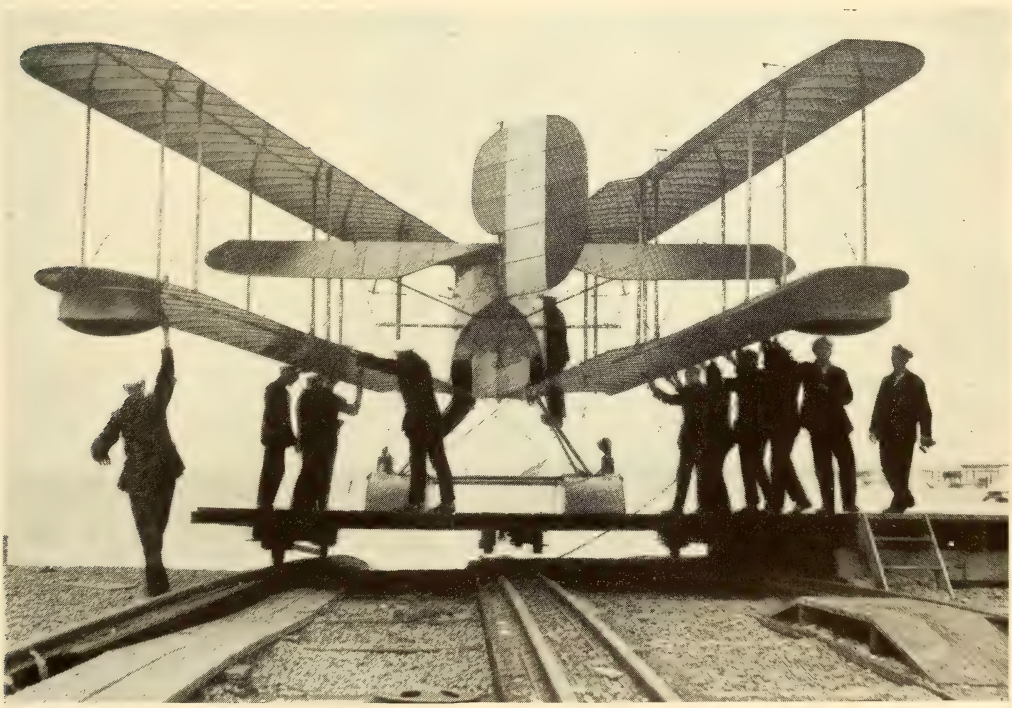
The Royal Flying Corps of Great Britain played an important rôle in the recent conquest of the Holy Land from the Turks. Neither the humble mount nor its Arab rider seems excited over the descent of the winged creature which is helping to restore civilization in the birthplace of Christianity.

© Underwood & Underwood

NO BOMBS WERE DROPPED BY THIS AIRMAN IN HIS FLIGHT OVER THE HOLY CITY OF JERUASLEM WHILE IT WAS STILL IN THE HANDS OF THE TURKS, FOR HIS MACHINE BORE THE EMBLEM OF GREAT BRITAIN AND OF CIVILIZATION

In the foreground is seen one of the holy pools, while the conspicuous structure in the middle background is the Dome of the Rock, a mosque erected over the rock upon which once stood the altar of burnt offering. According to Arab tradition, the Holy Rock covers the abyss in which the waters of the Flood are heard roaring, and it was here that Abraham was on the point of slaying Isaac for a burnt offering.

CAMEL MACHINES IN FLIGHT OVER A BRITISH AËRODROME



AN AIRPLANE WITH FOLDING WINGS, USED IN THE BRITISH ROYAL NAVAL AIR SERVICE

The possibility of landing on the deck of a warship after a flight in air was first demonstrated by the late Eugene Ely on the United States cruiser *Pennsylvania,* off the coast of California. He alighted on a platform on that vessel without mishap to himself or his machine.

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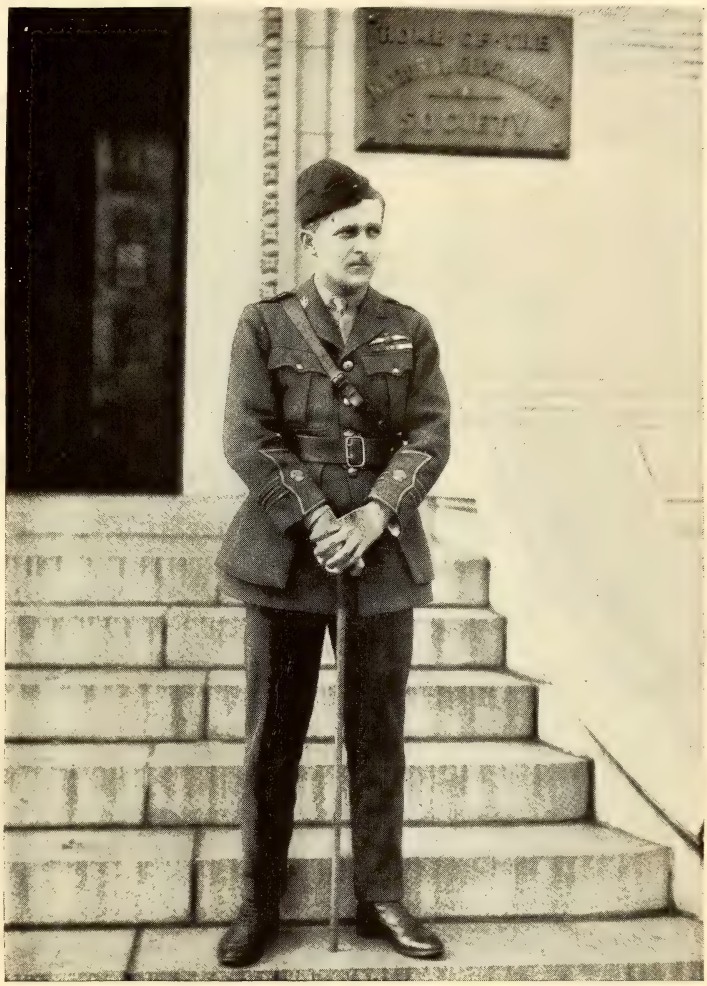
THE PARACHUTE IS THE BALLOONIST'S LIFE-BOAT

This British observer, his balloon destroyed during the battle of Menin Road, in Flanders, descended into a treetop. While his comrades were climbing to his aid the observer succeeded in swinging on one of the ropes of his parachute to a near-by truncated tree, from which he slid to safety.

saw the others come out of their machines he tore off again and flew away from them.

By the time the first of the Huns had been able to get off the ground, Ball was over half a mile away and had made good his escape. The risk he took in landing this way was very great, as his engine might have stopped when he landed, in which case there would have been no way of starting it again and escaping.

On another occasion, about six months later, he had an experience just as thrilling as the one above. He had chased an enemy machine for ten miles behind its lines and, on turning to come home, found himself cut off by several groups of the enemy. Picking out a group just in front of him, and the smallest group which was trying to cut him off, he decided to fly straight at the machines and through them. There were four in the party, and as he flew toward them they all opened fire at him, while he did the same at them.



Photograph by Charles Martin

MAJOR WILLIAM A. BISHOP ON A VISIT TO WASHINGTON

While in the National Capital, a few days before his return to the front, Great Britain's greatest airman called at the headquarters of the National Geographic Society to give the accompanying account of several of the exploits of his fellow aviator, the late Captain Albert Ball, V. C. During his stay in this country Major Bishop has rendered valuable assistance to American officers charged with the development of our great air fleet.

The leader of the enemy patrol did not like it, however, and swerved to one side, just as Ball was hoping he would. Two of his followers did the same thing, perhaps in the hope that they would be able to catch Ball from the flank; but it was all according to Ball's plan and he carried on straight at the last man, whom he hoped would also turn.

At a speed of 250 miles* an hour they approached, both firing two machine-guns at each other. It looked as if they were going to go into each other. Both men seemed determined that they would not swerve the slightest. Ball told me later

* They were each moving at 125 miles per hour.

Photograph by Central News Photo Service

BRITISH AIRMAN GIVING A "PASS-WORD" SHOT TO HIS OWN MEN BELOW

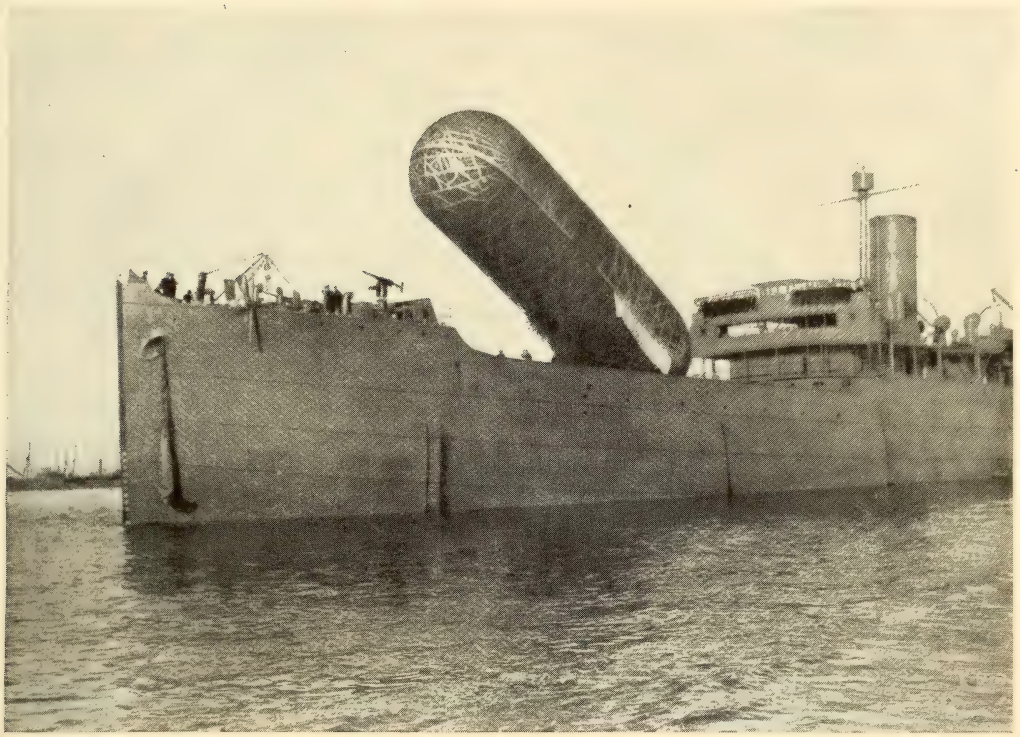
It not infrequently happens that anti-aircraft gunners mistake one of their own fliers for an enemy. In such cases the aviator fires a smoke signal from this type of revolver to identify himself as a friend. Today the signal may be two puffs of white smoke; tomorrow it may be three. It is the "pass-signal" of the skies.

that he was quite sure in his own mind that the man intended ramming him and thus causing death to them both.

Many bullets struck Ball's machine, one hitting an oil pipe, allowing the oil to leak and splash over him. His face was covered with it and some of it got in his eyes and he could hardly see. He closed his eyes and flew straight, firing as he went, expecting every second to hear the awful crash when they would strike. The other man, however, when only about twenty yards away, suddenly dived down and went straight to earth, where Ball saw him crash into the ground.

Upon looking back upon the encounter Ball came to the conclusion that he must have killed his adversary with an early shot and the way in which the German fell back in his seat must have just held the machine in a level position for the length of time while he came on straight at him. Ball thought the man's fingers must have remained on the triggers of his guns.

Ball managed to escape the remainder



H. M. S. "CANNING" AND ITS KITE BALLOON

The captive balloon is the all-seeing eye of a warship. It not only gives warning of approaching enemy fleets, but it readily detects the lurking submarine. It also directs the fire of long-range guns.

of the crowd, but a little later he had a most terrifying experience. While crossing the lines he had to pass over a very intense battle raging on the ground. Shells were dropping everywhere and he knew that in flying over this ground he was passing through air which was literally full of shells in their flight.

Suddenly, with an awful sound, a shell struck his machine about two feet behind where he sat, passing clean through the body of the machine without exploding. The unfortunate part of it was that in passing through the machine it practically severed all his control wires, which meant that all the mechanism which directed the machine—except a few strands of the cable—had been destroyed.

His machine immediately went into a spinning nose dive and fell, out of control. Simply by means of the most delicate handling and great skill he managed, when only 2,000 feet from the ground, to regain control of his machine and headed it in the direction of home. Any ordinary pilot would have been content to come down and land in the first field; but not so Ball. His aërodrome was still twenty miles away; yet he flew this damaged machine all the way to it and landed there without further damage.

His flight home must have been a terrible experience, as the shell in passing through his machine had strained it and damaged it tremendously, and at any moment the whole machine might have collapsed and fallen in pieces; yet Ball, with his customary coolness and courage, brought it back home to his aërodrome and landed. Twenty minutes later he was in another machine and on his way to the lines to look for another fight.

Photograph by Paul Thompson

A MAMMOTH BRITISH HANDLEY-PAGE BOMBING MACHINE SHOWN IN COMPARISON WITH ONE OF THE SMALL 125-MILES-AN-HOUR FRENCH WARPLANES

The large machine is the type of plane which recently electrified the world with its 2,000-mile flight from London to Constantinople by way of Paris, Lyons, Marseilles, Spezia, Pisa, Rome, Otranto, and Saloniki. On the last lap of the journey it carried a cargo of 16 bombs, many of which eventually found their targets—the cruiser *Goeben* and several other warships anchored in the harbor of the Turkish capital. On returning to its base at Saloniki, after a round-trip night flight of 640 miles in seven hours, the plane was found to have been punctured by 26 bullets.

A QUINTET OF BRITISH AIRSHIPS SETTING FORTH ON PATROL DUTY

This striking view of an English sky fleet was made from a sixth dirigible. Note the typical English landscape with numerous hedges and rows of trees dividing the fields into odd-shaped polygons.

Photographs from Geoffrey Butler

ONE OF THE BRITISH COASTAL AIRSHIPS LANDING IN A GALE

ITALY'S EAGLES OF COMBAT AND DEFENSE

Heroic Achievements of Aviators Above the Adriatic, the Apennines, and the Alps

By Kindness of General P. Tozzi, Chief of the Italian Military Mission

IN THE supreme struggle of civilization the employment of twentieth century warfare's most important weapon, the airplane, has entailed tremendous sacrifice and called forth inspiring deeds of heroism on the part of Italy's airmen.

None of the other Allied nations has faced such a variety of difficulties in the terrain over which its flyers have had to operate incessantly since the peninsula kingdom declared war on Austria in May, 1915. For two years the battle line ran tortuously among the perpetual snows of the Alps, and high above the mountain peaks Italy's aviators performed with stoic fortitude their patrol of the skies, ever watchful of the enemy's planes and keenly alert in scouting for information to aid their own advancing Alpine troops.

While one branch of the Italian aviation service has been employed as auxiliary to the land forces, an even more numerous force had to be organized at the beginning of the war to protect Venice and many other beautiful and historic

A SALVAGE CREW HOISTING AN ENEMY AIRPLANE WHICH BECAME A SUBMARINE AFTER AN ENCOUNTER WITH A VICTORIOUS ITALIAN AIRMAN

Photograph by International Film Service

SENTINEL OF THE SKY

High up in the snow-covered Alps, circling above the rocky Dente del Pasubio, the lone Italian airplane is a veritable sky sentinel. In this picture the Italian machine is chasing an Austrian Albatross which attempted a raid on the Italian position on the mountain top.

cities of the Venetian plains from the ruthless bombing raids of enemy airplanes. Fleets of seaplanes were also required to patrol the long Adriatic seaboard of the peninsula to give warning of the approach of raiding Austrian warships, while a constant lookout maintained for enemy submarines was no small part of the duties performed by the Italian air forces.

With mention of her defensive and scouting air service, developed in the face of a foe already thoroughly equipped in this branch of warfare, the story of Italy's air achievements only begins. Tremendously effective has been the destructive work which this nation's aviators, piloting huge Caproni cars, have wrought on Austrian naval and military bases—Pola, Fiume, Trieste, and Cattaro.

TWO EXAMPLES OF ITALY'S AIR ACHIEVEMENTS

Two concrete examples of Italian exploits in the air are typical of countless deeds involving exceptional skill, undaunted perseverance in overcoming enormous difficulties, and magnificent daring in the face of death and disaster.

A short time ago two squadrons of Caproni bombing machines, rising at four-minute intervals between units, flew from a base aviation camp, located somewhere in the Venetian plain, to another camp in the vicinity of Milan. This was the first lap of a history-making expedition through the air. The start for the second lap, from Milan to Rome, was made at 8 o'clock the following morning.

Rising from a sunny field in Lombardy, the machines had proceeded only a few miles in their southward flight toward the Apennines when they were enveloped in dense banks of fog and masses of cloud. But on they flew, the pilots guided only by their compasses and barographs.

Over Piacenza they soared, but that city was hidden from the air voyagers by impenetrable mists. Now, according to their calculations, they were approaching the foothills of the Apennines. They began to mount higher and higher, until their barographs registered an elevation of nearly two miles—a height sufficient to enable them to negotiate the rift in the peaks known as Cisa Pass. The calculations were accurate; had they been even slightly in error, the great machines, their pilots sightless amid the clouds, would have shattered their wings against the rocks, like migrating birds dashing themselves to death against the walls of lighthouses in their night flights to southern climes.

CAUGHT IN DANGEROUS CROSS-CURRENTS

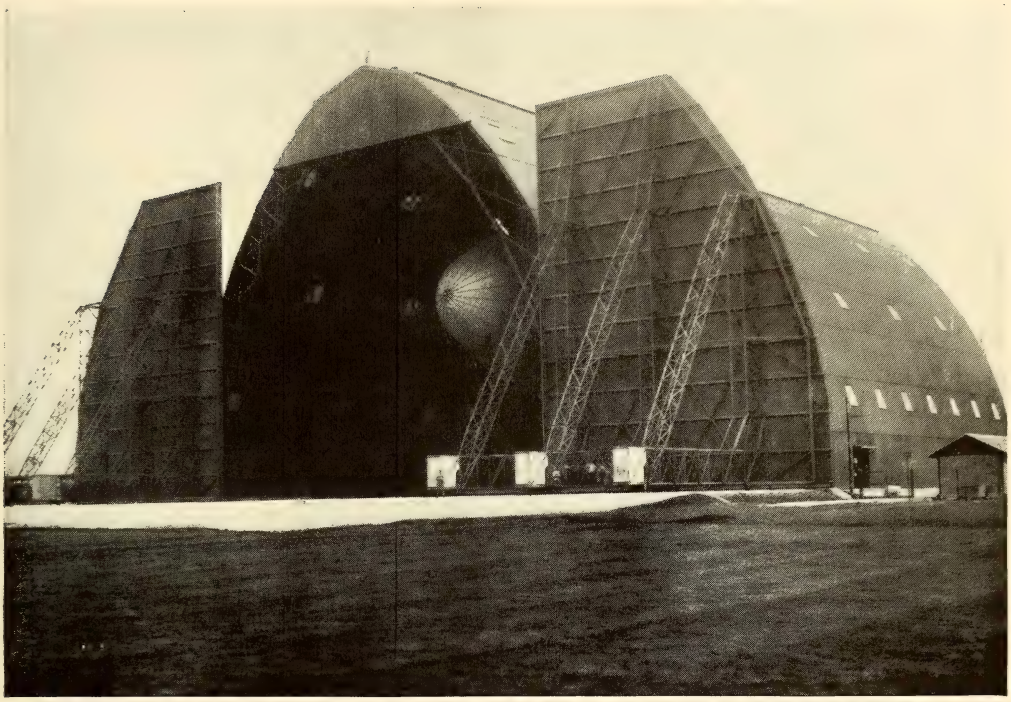
Once over the great range of mountains known as the backbone of Italy, the pilots dropped to within a few thousand feet above the land, between the cities of Spezia and Massa, on the shores of the Ligurian Sea.

Scarcely had the air fleet emerged from the clouds, however, than they were caught in the dangerous cross-currents lying between the mountains and the sea. The machines rolled and pitched like cockleshells in a choppy sea. Safety had to be sought in smoother air strata, and the groups of airplanes were forced to break up into units in their search for less turbulent currents.

A whimsical fate directed one of the pilots over Viareggio, his home town, and as the whir of his propellers was heard in the distance the people gathered at their doors to watch the birdman soar by. Passing within a hundred yards of his own house, the pilot waved his hand to the aged couple standing on the steps gazing with eager eyes at the giant aircraft but ignorant of the fact that it was their own son in the seat of honor.

Past Pisa and Leghorn and over the Lake of Bracciano the squadrons flew, and shortly before noon, after a great spiral evolution over the Eternal City, they descended in the rain on the field of the great aviation camp which lies almost in the shadow of the Seven Hills. The trip from Milan, through fog and over mountain, had been accomplished in less than four hours. The second lap in the journey had been completed without accident.

At ten the next morning the two squadrons once more spread their wings, heading this time toward the southeast, their



Official Italian Photograph

THE DOORS OF AN ITALIAN AIRSHIP STABLE ARE STRONGLY BUILT, IF NOT ALWAYS LOCKED

Danger lies not in the theft of the machine, but in the irreparable damage which would result if a gale should blow the doors in upon the dirigible, rip the gas bag, and derange the delicate mechanism.

objective being the Adriatic seaport of Brindisi, famous in ages past as the port of debarkation for many historic expeditions against the enemies of Rome.

It was a five-hour journey, performed according to schedule in spite of the fact that at one time the airmen were forced to mount several miles in order to rise above a thunderstorm. Thus ended the third lap.

THE FLIGHT ACROSS THE ADRIATIC

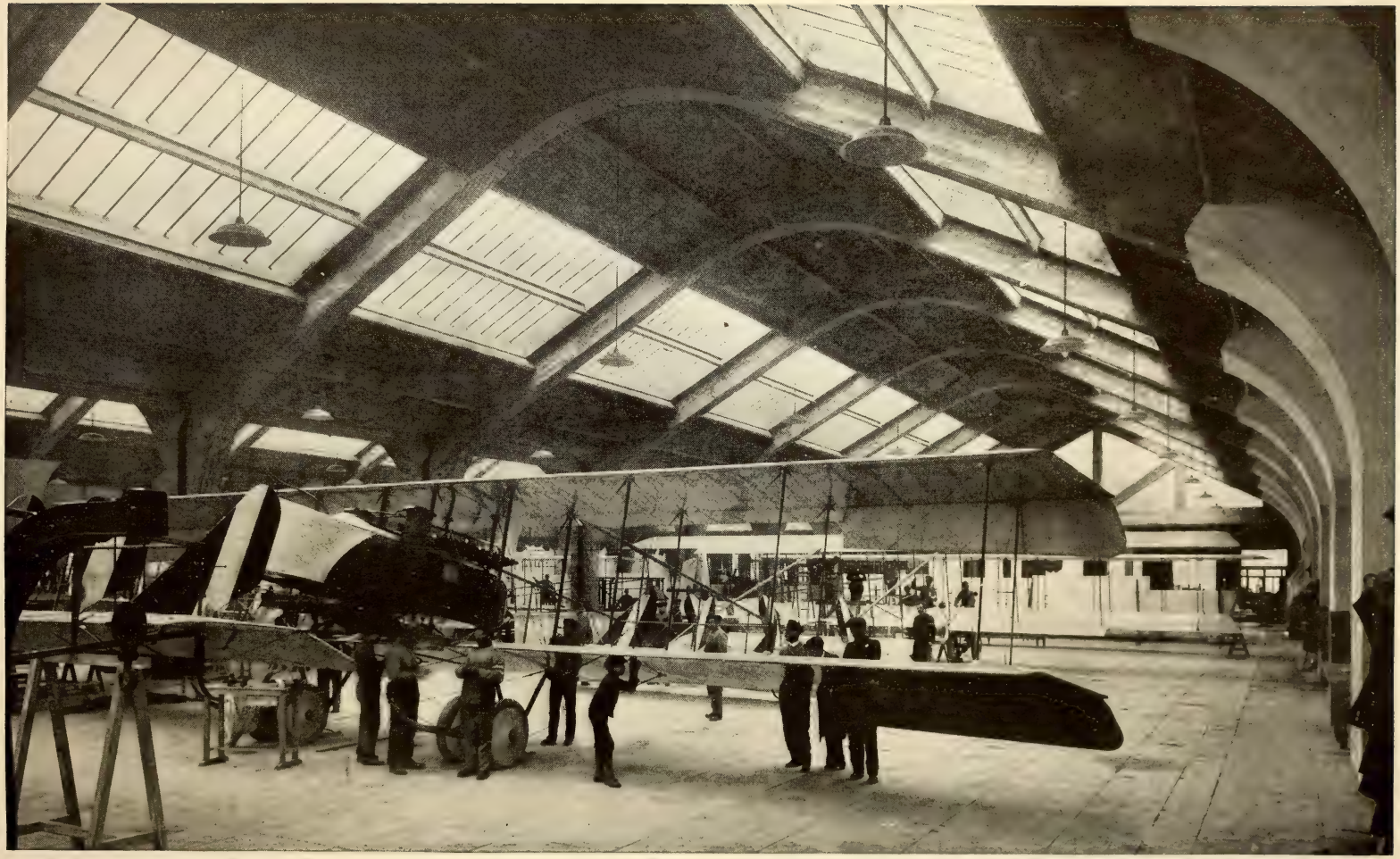
The fourth and final stage of this momentous expedition was begun after darkness had closed in upon the Adriatic. Reserve tanks of gasoline had been attached to the machines, assuring fuel for a six-hour continuous flight at top speed, for these were not hydro-airplanes, and a sudden descent into the sea would have meant the loss of planes, pilots, bombers, and observers.

As the great night-birds set out over the sea, steering in a northeasterly direction, a dim glimmer of lights flashed from the waters like the fitful glow of fireflies. These were the Italian torpedo-boats marking the way for the airmen.

After a flight of more than 150 miles across the Adriatic the dim shoreline of Montenegro was vaguely discerned through the mist. A half hour longer and the squadron veered to the north, over the Lake of Scutari.

Soon the darkly wooded mass of Monte Lovcen (the Black Mountain, from which the Kingdom of Montenegro takes its name) loomed like a vast shadow upon the horizon. Passing to the east of this peak, the Capronis soared over Cettinje, where Austrian lights twinkled in what was once the palace of King Peter. No bombs were dropped here, for all were needed to wreak destruction upon Cattaro, which the raiders were now rapidly approaching.

Suddenly the searchlights of the Austrian ships in the basin of Cattaro harbor began to cut the skies; the whir of the Italian planes had been heard. Almost simultaneously with the realization that danger was at hand, the Austrians began



Photograph from Capt. Lamberto Vannutelli

A MAMMOTH GLASS, STEEL, AND CONCRETE HANGAR OF THE POMILIO FACTORY FOR A GROUP OF POWERFUL ITALIAN RECONNAISSANCE MACHINES

These planes, regardless of the wind, rain, and snow, continuously fly over the enemy's lines, taking photographs of the Austrian trenches and positions, and, by means of wireless apparatus, notifying the Italian artillerists of the location of enemy batteries

A GROUP OF ITALIAN HYDRO-AIRPLANES ABOUT TO START ON A MISSION

Official Italian Photograph

Photograph from Capt. Lamberto Vannutelli

SQUADRONS OF ITALIAN AIRPLANES READY TO MOUNT ABOVE THE ALPS

Few fighting airmen have encountered so many difficulties and with such signal success as have the Italians. They have had an extended sea-coast to defend against a near-by enemy; they have had a vast sea area to patrol in search of submarines, and they have been forced to carry on their above-land operations among the snowy heights of the Alps and the Apennines.

Official Italian Photograph

THE BLACK CROSS OF DEFEAT

An Austrian airplane brought down on the Italian front

to feel the deadly blows from above. Fires in arsenals, shipyards, and warehouses began to flare in the wake of low-flying machines, and the noise of the anti-aircraft guns was mingled indistinguishably with the detonation of exploding bombs.

Releasing their remaining explosives upon the island of San Marco, the two squadrons, unscathed by the shots from the fort batteries, successfully eluded the Austrian airplanes and made the return flight without loss or further incident, having performed one of the most extraordinary feats of the war. Cattaro was supposed to be Austria's most inaccessible naval base.

While not so noteworthy in the character of its military mission, even more thrilling was the bombing raid carried out by a squadron of twelve Capronis from a base near Pordenone, the objective being a strong Austrian railway center and supply depot 100 miles distant.

The bombing machines were under the direction of Squadron Commander Barbieri, mounted in an airplane piloted by Captains Salomone and Bailo.

Scarcely had the fleet taken the air when a dense fog was encountered. In it several of the units became separated from the main group, and among these was the machine of the commander. When the enemy lines were reached Colonel Barbieri was cut off from his companions, and the Austrian pursuit planes singled out the commander for destruction.

A terrible battle ensued, the Barbieri airplane being attacked on all sides by the Austrian combat planes. The Italian pilots jockeyed for position with daring evolutions, while their machine-gun spurted a constant stream of bullets. Finally, Colonel Barbieri, who was working the forward aircraft gun, was struck in the forehead and lay lifeless on his weapon.

But the struggle continued, for Captain Bailo, who had left Captain Salomone to steer the airplane, worked the rear machine-gun without a moment's pause. Soon he also was hit and fell dead in his seat. Still Salomone would not surrender. Seated between his dead companions, tense over his controls, he

Photograph by Edwin Levick

THE GREAT CAPRONI BIPLANE FLYING NEAR THE WOOLWORTH TOWER, THE TALLEST BUILDING IN THE NEW WORLD, ON SECOND LIBERTY LOAN DAY

This gigantic plane sailed from Newport News to New York with ten passengers. With its Italian pilot, it also flew from Newport News to the National Capital and return, following the course of the Potomac. Although a ten-passenger aircar, this machine is only the "little brother" of the Caproni triplane, which has a carrying capacity of 25 passengers.

continued to defy the enemy. A bullet struck him in the head; he was blinded by his own blood.

The Austrian planes were now certain of their prey. Perceiving the two dead passengers in the car, they made signs to the pilot to surrender. But Salomone's will was firm—the Italian machine must not fall into enemy hands! With unparalleled fortitude he maneuvered incessantly and, although seriously wounded, succeeded in escaping from his assailants. He brought back to the Italian camp his machine with the bodies of his fallen comrades.

In addition to the marvelous work done by the Italian bombing machines is to be recorded the admirable daily work of the reconnaissance Italian machines, which, regardless of the rain, wind, and snow, continuously fly over the enemy's lines, taking photographs of the Austrian trenches and positions, and by means of the wireless apparatus notifying the Italian artillery of the location of the enemy's batteries. And when, on dark nights or

in the early dawn, the Austrian and German planes come to bombard our open cities and barbarously to destroy the art treasures of Venice, of Padua, and of Verona, then it is that our courageous combat pilots mount at once to the sky and, with firm hand and stout heart, meet and bring down the invaders—as, for instance, Major Baracca, who brought down 30 of the enemy's machines, and Colonel Piccio, who brought down 20.

The achievements of Italian aviation during the last three years have not been confined to the theater of war. Its pilots recently have established new world records for non-stop flights, for speed and altitude. The plaudits of the Allied nations recently sounded for an Italian aviator, Captain Laureati, who piloted a Sia plane from Turin over the Alps, across France and the English Channel to London, a distance of 700 miles, without alighting; but this distance record was almost immediately eclipsed by the same pilot, with another non-stop flight of 1,004 miles, from Turin to Naples and return. Another Italian aviator, Lieutenant Guidi, established the record for highest flyer of the world when he took his machine to a height of 26,400 feet, five miles above the earth and more than two miles above the summit of Mont Blanc, the loftiest mountain of Europe.

Sergeant Stoppani, piloting a one-seater fighting airplane, type "Savoia-Verduzio," on the 28th of September, 1917, left Turin at 2.45 p. m., crossed the Apennines to the sea, and, following the shore line, arrived in Rome at 5.35 p. m., covering a distance of 390 miles in two hours and fifty minutes and at an average speed of 138 miles an hour.

These achievements are indicative of the place Italy is expected to take in the development of aviation when the world is once more at peace and men's minds may turn with confidence to the productive pursuits of transportation and international commerce.

THE ITALIAN RACE

WHILE most of America's airmen will probably see service above the battle-line which extends from the North Sea across Belgium and France, they will not be forgetful of the superhuman skill, daring, and self-sacrifice of their allies beyond the Alps, the intrepid Italians, whose country produces no coal, no steel, and food insufficient for her needs, yet has managed for nearly three years to maintain her armies against the ceaseless hammering of Austrian and German guns.

Italy, the mother of civilization, of art, and of science, and the cradle of intellectual liberty, began fighting the invaders from the North a thousand years before the discovery of America. She has given to the world Marcus Aurelius and Dante, Columbus and John Cabot, Leonardo da Vinci and Galileo, and in more recent days Volta, Galvani, Garibaldi, Verdi, and Marconi.

Just as the New World was given to civilization by her two great navigators, Columbus and Cabot, so the infinite realms of space were revealed to man through the gift of the telescope from Galileo, that monumental genius who also helped to perfect the compound microscope which has made modern medicine and modern chemistry possible. Likewise it is Marconi's gift of wireless telegraphy which makes the observation airplane a truly potent factor in battle.

One of the marvels of human history is this extraordinary Italian race, that for 2,000 years has blessed the world with one succession of geniuses—musicians, authors, creators of inspiration and advancement—from which all other peoples have benefited.

THE EDITOR.

BUILDING AMERICA'S AIR ARMY

By Lieut. Col. Hiram Bingham, Signal Corps, U. S. A.

Chief of the Air Personnel Division in the Office of the Chief Signal Officer of the Army

AFTER a trip halfway around the world, there arrived recently in a Southern port of the United States a large steamer loaded with castor-oil beans. During its voyage many thousands of acres of ground were being made ready to receive the cargo the moment it was discharged, and factories even now are being prepared to turn the forthcoming crop into lubricants.

Here is a little side glimpse into the new industrial problems created in the manufacture of America's wings. America, though in a sense the home of lubricating oils because of her enormous factory system, had not in her whole long list one which could stand up under the power of the Liberty Motor. All of them scotched and burned in this new-found strength.

The lubricant from the castor-oil bean, however, proved a single exception. Unfortunately the growing of these beans had been discontinued, owing to the influx of cheaper beans from India. The importation of these had been stopped recently by an embargo put into effect by the British Government. The only solution to the problem was to reëstablish the castor-oil bean-raising industry in America. By a special arrangement with Great Britain a cargo of beans held at Bombay was released and rushed to this

LIGHTNESS WITH STRENGTH

If 60 people can sit on the *unsupported* end of one pair of wings of an airplane, as shown here, we need have no fear that these wings will "crumple up" in the air

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WOMEN AT WORK ON THE WINGS OF VICTORY

The planes of a flying machine are covered with a special quality of Irish linen, which is stitched tightly over the framework by women seated on opposite sides of the plane and using three-inch needles. The British Government has promised that linen in sufficient quantities will be supplied to the United States as rapidly as needed to complete our airplane-building program (see page 55).

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AT A PUNCHING MACHINE IN AN AIRPLANE PARTS FACTORY

The world is no longer a stage with the men and women merely players, but a vast machine shop where each must do his or her bit—in this instance punching, and punching with care, the fittings for a flying machine.

country. Meanwhile, necessary preparations were made for planting the crop and extracting the oil when the harvest shall have been gathered.

This has been done, as so many other new, unexpected, and surprising things have had to be done, in building up America's Air Army. If ever there has been a succession of unforeseeable needs, of baffling problems, and of almost heroic methods to hew through to results *in time,* it has been in the effort to establish upon almost no foundations whatever one of the most intricate, and I am not sure it is not the most intricate, industry in the world. I only wish it were possible to thrill others with a little of the romance of this new industry which has so thrilled us here in Washington during the past six months of effort.

Many people think an airplane is a simple thing to build—a pair of wings attached to some sort of body, with an engine in between and a propeller in front. A few rough cuttings, it is pictured, a little nailing up, and the machine is ready. This is not at all surprising, for even many manufacturers themselves are ignorant of the fine workmanship and materials which must go into an airplane.

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GIRLS MAKING AIRPLANE TURNBUCKLES

Every job in the manufacture of a flying machine is a responsible job, for, like the famous One Hoss Shay, every part must bear its burden of terrific strain as long as any other part.

Colonel Deeds has in his office a letter from a manufacturer who gave two dredges, among other things, as equipment on hand which might work in somehow in airplane work.

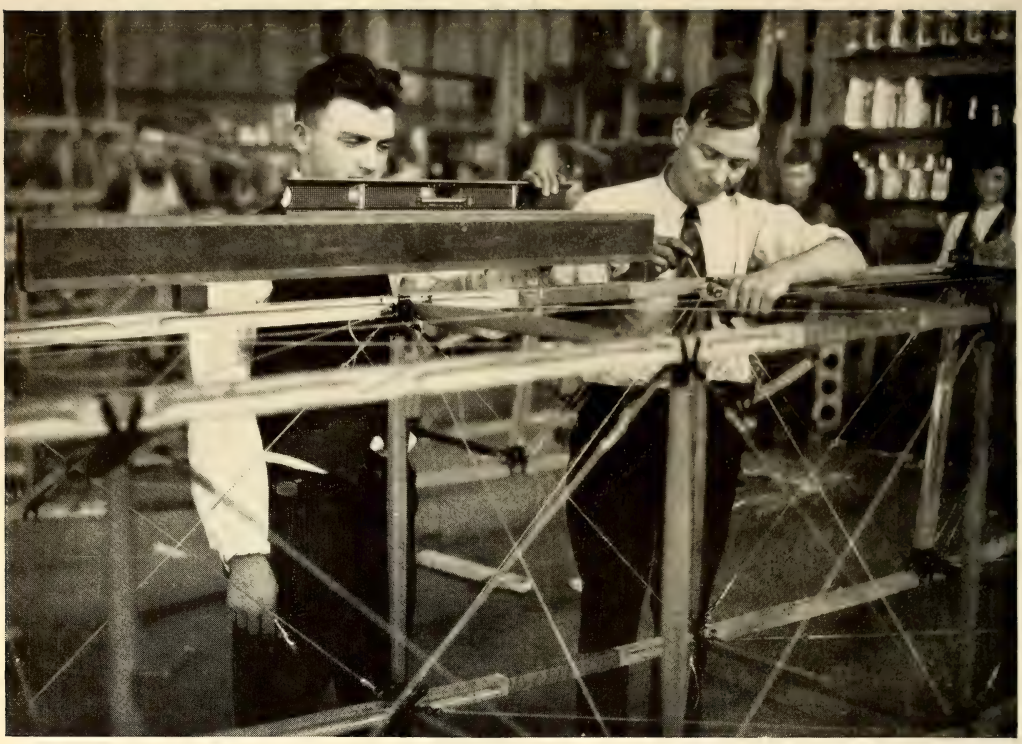
Let me try to depict by a rough picture a plane in the making. Suppose, for instance, you were set to driving 4,326 nails and 3,377 screws. Undoubtedly that would be quite a task—a total of 7,703 separate operations. Well, when you had reached the 5,000 mark you could truthfully be told that you had done less than two-thirds of the work of this sort required for a single airplane. (These figures are for a training plane; for a French battle-plane 23,000 screws are said to be needed.) Somehow a plane looks so simple and floats so gracefully through the air that we lose all thought of the skill that goes into its making.

ONE OF AMERICA'S AIR TRIUMPHS

Just recently we have received some figures of the material which is required for one of the simpler training planes. For instance, 921 steel stampings must be cut out, 798 forgings cast, and 276 turn-buckles, all for a single machine.

Think, then, of the hundreds of thousands of such pieces needed for the thousands of planes in the American program and of how utterly hopeless the situation would be if those parts were not standardized, turned out by machinery in tens of thousands, and usable in scores of different factories on any kind of plane. The reduction of aircraft manufacture to the simplest, standardized, quantity production basis has been one of America's great triumphs in the air and an achievement which very soon will be making itself felt.

But metal must be used in an airplane as little as possible. It is altogether too heavy, especially when a few extra pounds make all the margin in speed between victory and defeat. An engine of 300 horsepower is in itself enormously heavy to rise into the air; so that the rest



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TRUING THE AIRPLANE, ONE OF THE VITAL INITIAL STEPS IN THE CONSTRUCTION OF AMERICA'S SKY FLEET

A manufacturer who wanted to build flying machines for the government, but whose bid was rejected because his plant was inadequate, was very wroth and declared scornfully that he could whittle an airplane out of a tree in a few weeks' time, at a cost of a few hundred dollars. The illustration shows one of the necessary operations which the whittler would have overlooked—the establishment of an exact level for the key part of the fuselage, or body. The man to the left is watching the bubble in the spirit-level, while the other mechanic is adjusting the supports to the required tautness.

of the machine must attain the very acme of lightness.

That very lightness, however, entails enormous strength and perfect adjustment. Think of the strain which is exerted on every wire and nut, every inch of linen, and every bit of wood as this 300-horsepower mechanism rushes through the air at 150 miles an hour. Cyclones often do not go as fast, and we can easily picture what happens to a strongly built house when the air strikes it at that speed.

TREMENDOUS PRESSURES MUST BE WITHSTOOD

But if the strain is great simply because of high speed, what must it be when a plane suddenly careens downward, taking a tremendous pressure off one part and hurling it upon another. It is that kind of sharp, sudden, unevenly distributed shock which allows the slightest tap of a knife to crack an egg or the explosion of a depth bomb to crush in the unprepared side of a submarine. Obviously a plane must be built so skillfully and of such perfect material as to withstand not only the pressure of its cyclone speed, but also the added shocks of its sudden evolutions.

The one material which gives this double characteristic of strength with lightness is spruce; not the ordinary spruce, but a super-selected spruce from the giant trees of the Pacific coast. Few would believe that this would present much of a problem with America's vast resources; but when one considers that only a small fraction of the very best spruce is usable at all, and that the war has vastly increased the demand for that,

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AMERICA'S WOMEN ARE ENLISTED IN THE AIR SERVICE OF THEIR COUNTRY

Not only in munitions factories does the skilled workwoman find her opportunity for war service. Filing fittings for the wing spars of airplanes is this girl's task.

the difficulty will begin to appear. Let me explain this in detail.

The ideal trees for airplane spruce are the fine old patriarchs, scarce enough at best, which have a girth of about 14 feet and run up 160 feet without a branch. Now when this splendid wood is cut 52 per cent is thrown out at once—the part in the heart where the grain is too circular and the part at the circumference where the grain is too coarse. Another 10 per cent is culled out for various reasons and another 7½ per cent lost in kiln shrinkage. This leaves us less than one-third of our original wood for further selection.

Of this third, however, only a small proportion is fit for the more delicate work. Less than 1 per cent of it has the necessary length and strength for ailerons; 2.3 per cent is fit for the wing beams; 4.6 per cent for the long struts, and the same for the landing gear. The balance can only be used for ribs and the smaller fittings.

STRAINING AMERICA'S LUMBER RESOURCES

These figures show why America's vast lumber resources are being strained to the limit to build our air fleet. They explain also why it has been necessary for

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WINGS FOR THE AMERICAN BIRDMAN

Upon the flawless strength of its parts may depend in some critical moment a precious piece of information or the life of one of America's "Aces"

the United States to take over the whole spruce output as agent for the combined Allied program and eliminate the ruinous competition which had prevailed between the English, French, and Italian governments.

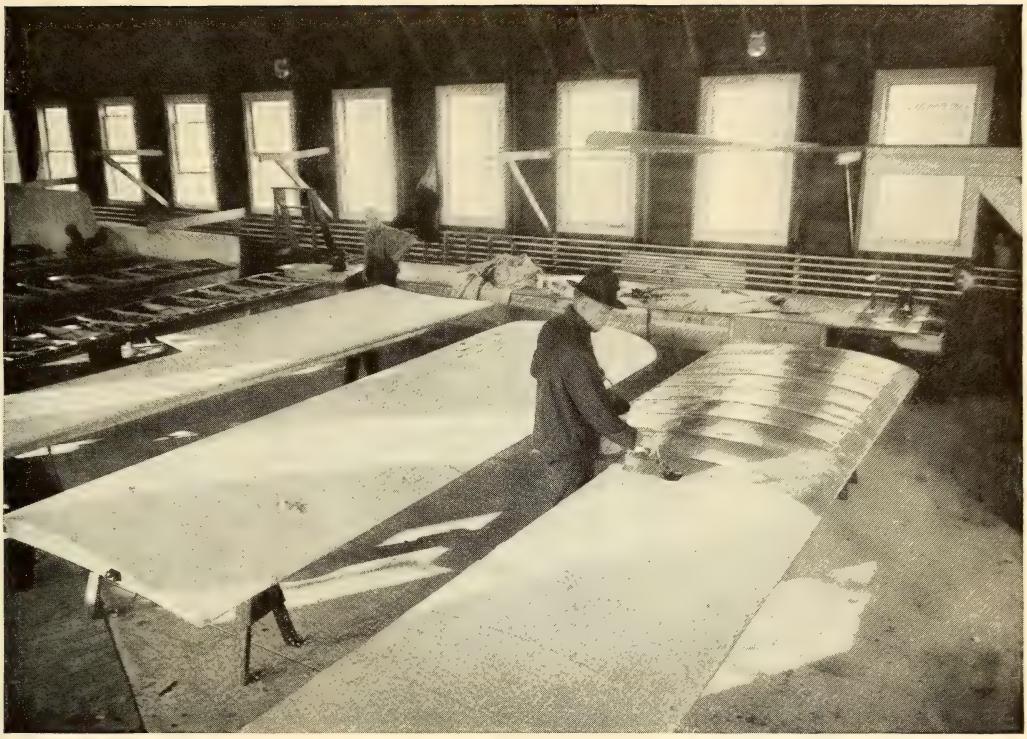
Despite every effort, however, the supply was still inadequate. There was neither the labor nor the mills to get out the necessary cut. Consequently Uncle Sam has had to go into the forests himself to supplement the present private resources. Lumber squadrons of several thousand men are being recruited to get out the trees, and additional mills are being set up to saw the overflow which the present mills cannot handle; for the war will not wait.

But, even with our lumber all milled, the task is but well started, for all the detailed cutting to standardized sizes, the construction into base units, such as wing-spars and ribs, and the assembling into completed sections of a plane still remain. Now that planes must be built by thousands, it is easy to see how vital it is to simplify and standardize each part so as to decrease manual labor as much as possible. It has, indeed, been no light task to harmonize all the conflicting sizes and shapes and bring them down to a few simple forms, especially when types are changing almost daily.

FOLLOWING AN AIRPLANE WING THROUGH ITS MANUFACTURE

Let us follow an airplane wing, for instance, through its various steps in manufacture. It looks simple enough as we see it all finished, with its slightly polished covering and its ultra-simple lines. Little does it show, as the face of a watch fails to show the delicate works within, that its making has necessitated the mobilization of the best workers and the best materials of America.

The lumber, as we have seen, comes to the factory roughly cut along standard lines. Here, however, it must be reinspected and a large proportion thrown out because of sap-pockets or deviations in grain. It must also be further shaped, reinforced in places of stress, hollowed



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"DOPING" THE WINGS OF AIRPLANES

In the parlance of the day, "dope" suggests sluggishness and lowered vitality, but in the manufacture of airplanes it means speed. Dope is a liquid compound with which the linen covering the wings of a flying machine is treated to shrink the fabric and make it taut over the framework, thus reducing its resistance to the air.

out in places of extra weight, and made ready as unit pieces. This is a task for the finest woodworkers or cabinet-makers.

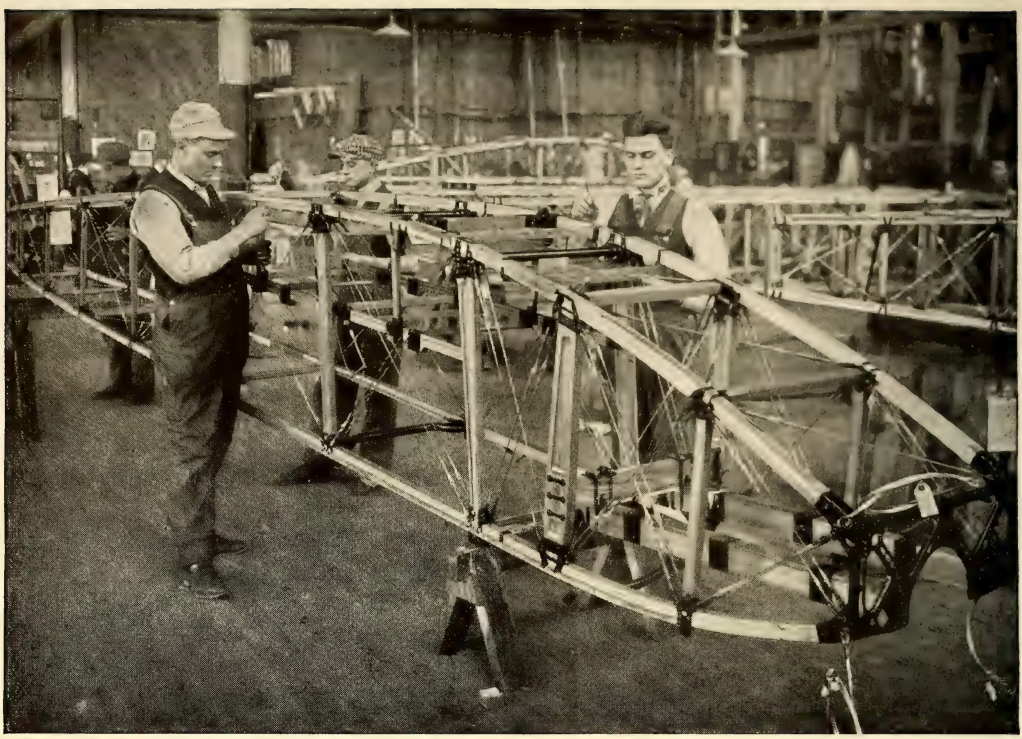
Then comes the laying of the keel, as we may call it, the putting down of the basic wing-spars, simple enough in appearance, but so carefully selected that their final cost is estimated at from $30 to $50 each. Next is the fitting in of the ribs, or cross-pieces, as many as 30 to a wing, and themselves coming to a final cost of about $9 each. Obviously, again, only an expert in woodworking can secure the exact setting required.

When finally all the ribs are firmly joined, the wing remains but a skeleton without the necessary covering to make it solid. Linen is the one perfect material known for this purpose, because it is light, strong, and will not rip, as cotton does, when pierced with bullets. But the supply of linen also ran short under the tremendous war demands, especially with that from Belgium and northern France cut off, and it was only when England mobilized all her strength that the world's best supply center in Ireland was able to rise to the demand. A little idea of how much is needed for the American program alone is found in the fact that each of our thousands of machines requires 201 square yards.

A MAXIMUM OF STRENGTH AND LIGHTNESS

Once secured, the linen must be cut to size, reinforced in places of stress, and then sewed in back and forth over each rib to make it absolutely tight and able to withstand a 150-mile wind pressure. This work is mostly done by women working in pairs, pushing a long 3-inch needle from one side to the other. No one has ever estimated the number of stitches necessary for a single plane.

When the sewing is completed, our wing is in a semi-finished state. It represents the maximum of strength and lightness which human ingenuity has as



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ARTICULATING THE SKELETON OF AN AIRPLANE'S FUSELAGE, OR BODY

Various parts of the framework of our flying machines and the metal fittings are made in widely separated factories. They are then shipped to assembling factories, where the parts are put together and wired by highly specialized workmen.

yet developed; but its surface is still rough and not yet drum-tight. To effect this, three coats of "dope" must be applied. This is a cellulose chemical preparation which was produced here only in small quantities before the war and of which 59 gallons are necessary for every plane. It contracts the linen appreciably, making it very taut and slippery, so as to decrease wind resistance. A final application of varnish to make the wing water-tight renders this part of the plane ready to be brought together with the other parts—engine, fuselage, propeller, controls, etc.

And so throughout the whole plane there is not an item which has not been built with infinite care and skill, balanced to the finest mechanical nicety, reduced in weight to the smallest margin of safety, always in the continued struggle to harmonize the antagonistic elements of lightness and strength. When, for instance, we look at the gently sloping curve on the fuselage behind the pilot, we are not apt to realize that some expert engineer has made this in place of a right angle in order to prevent air currents from eddying back and decreasing the speed of the plane several miles an hour.

Every sharp line, every superfluous wire, every unnecessary bit of material, adds to the weight and the wind resistance of the plane and holds up its speed through the air. Hence a continual struggle is ever going on between the experts of each army. With every enemy machine captured betterments are noted which further tax our industrial resources here and call for a higher degree both of skill in labor and of perfection in materials.

A DAY-AND-NIGHT RACE

I shall not repeat the story of the Liberty Motor, for that is well known; but I do want to place one question: Where has it been possible to secure sets of the accessories needed for every one of our thousands of machines, sets including a

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PUTTING THE FINAL TOUCHES ON AN AIRPLANE PROPELLER

Like the screw of the ocean liner, the air propeller of the flying machine is the primary medium of locomotion. It must be able to withstand a terrific air pressure, estimated at several tons, and must revolve with sufficient rapidity to drive the machine at incredible speeds, up to 150 miles an hour. These propeller blades are not made of single pieces of timber, but of from 10 to 25 pieces of walnut, mahogany, white oak, or cocoa-wood, all carefully laminated. It takes ten weeks to make a propeller, three weeks of that time being required to allow the parts to set after having been glued.

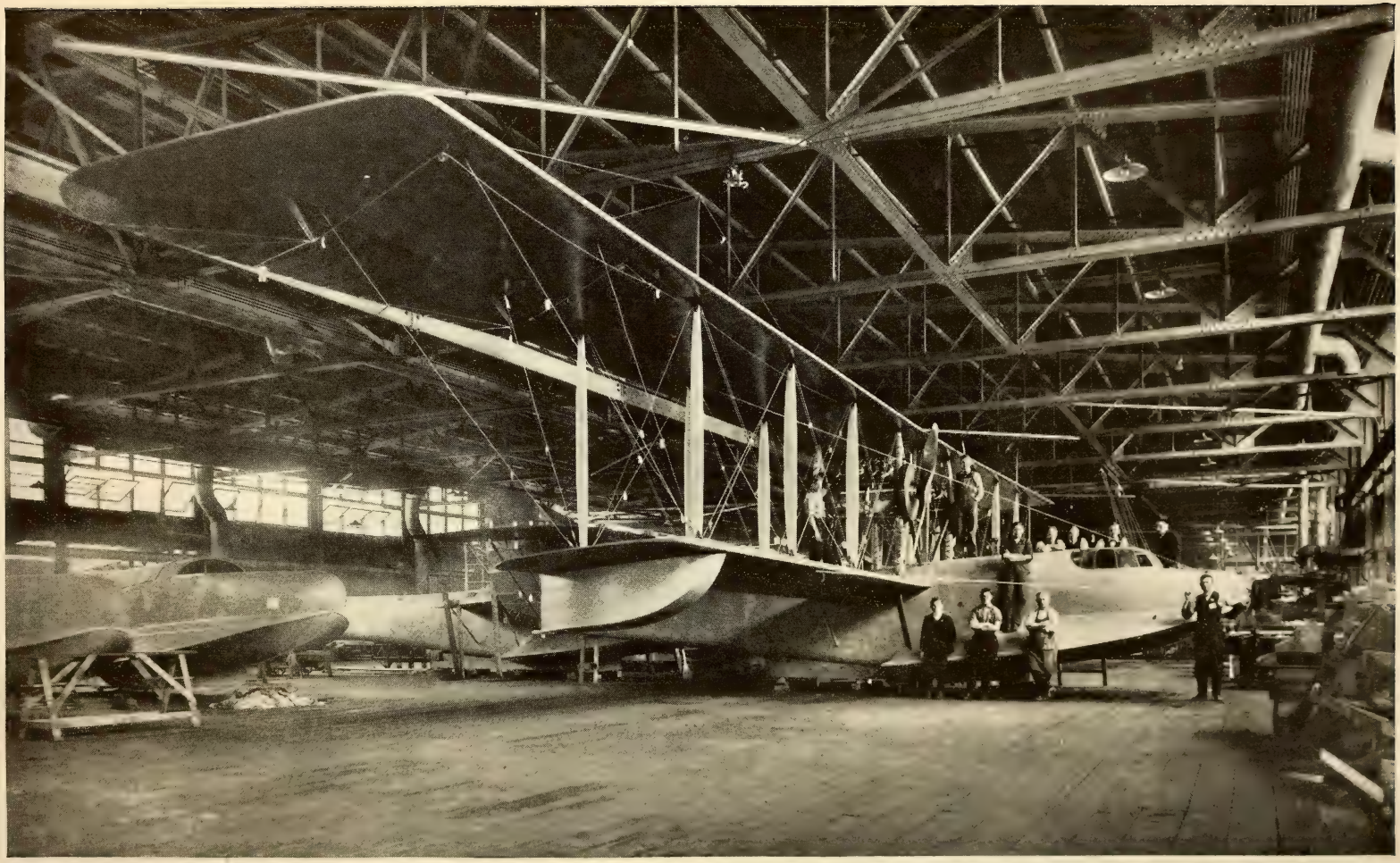
barometer, an air speed indicator, an aërial compass, an inclinometer, an altimeter, etc., the finest kinds of implements, practically non-existent in this country before the war? The mere names of the instruments and the skill which every layman would associate with their manufacture open up what has been another tremendous industrial problem in our Air Service.

Earlier in this article I used the word "intricate" in connection with airplane manufacture. Perhaps the foregoing statements will have demonstrated its correctness; but let me add a few other considerations. This program spells victory or continued deadlock abroad. Its completion means thousands of lives saved. Yet overprecipitateness means defeat and terrible losses. The two must be harmonized—a superhuman speed in building up a series of new industries, together with an absolutely infallible mechanical judgment and skill. Naturally the strain on those responsible is great.

I only wish the country might catch the romance of our new air industry. It is a day-and-night race against time along a course only semi-lighted and full of pitfalls. So far we have been fortunate in that the delays, the mistakes, and the difficulties have been largely offset by the unanimous effort and good-will which have met us on all sides. The race, however, is not yet over and will not be until peace is signed. And until then we need the intelligent interest of the public in the baffling but fascinating work before us.

THE EVEN GREATER PROBLEMS OF PERSONNEL

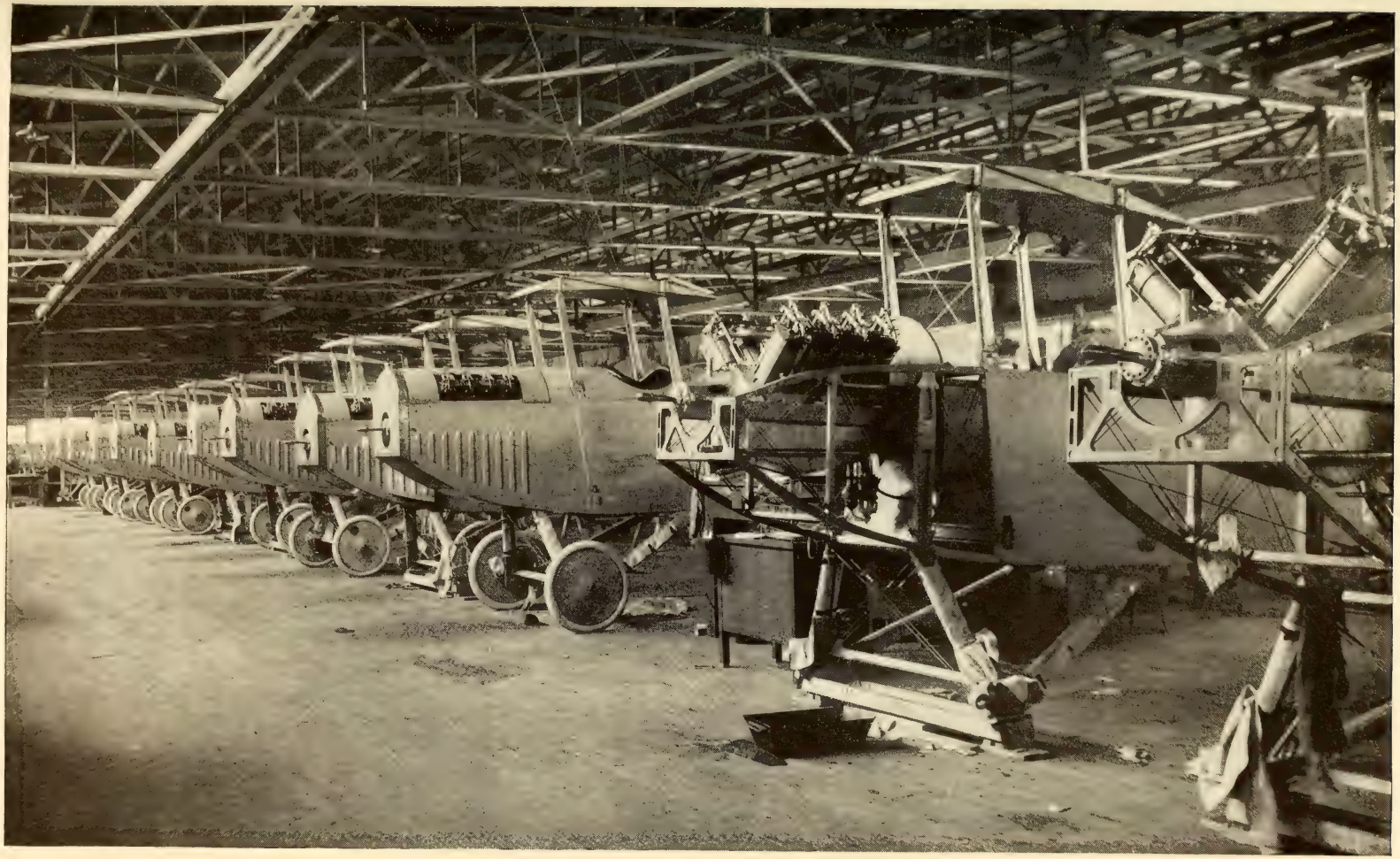
If the problem of providing machines and equipment for a great Air Army is one to tax the industrial and natural re-



Photograph by Central News Photo Service

BUILDING A GIANT HYDRO-AIRPLANE FOR AN AMERICAN PILOT

An aviator may sleep in a dugout, a tent, or under the open sky, but his plane requires a large, substantially built structure. Immense hangars of sheet metal, concrete, and steel are to be found in rapidly multiplying numbers throughout America. In France and Italy they are even more numerous.



A DOZEN FLEDGLINGS OF WAR ALMOST READY TO TRY THEIR WINGS

Various parts of the Liberty Motor are being manufactured in scores of factories throughout the United States, but the construction of the planes themselves is a highly specialized industrial science, requiring not only skilled workmanship, but the most watchful supervision, for a weak joint in the framework may mean death to the aviator.

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AN AIRPLANE IN THE CATERPILLAR STAGE OF ITS EVOLUTION

Before it receives its wings, the flying machine's motor mechanism is thoroughly tested. All the big plants where these craft are being made are under the protection of our soldiers, one of whom is to be seen on guard in the foreground of this picture.

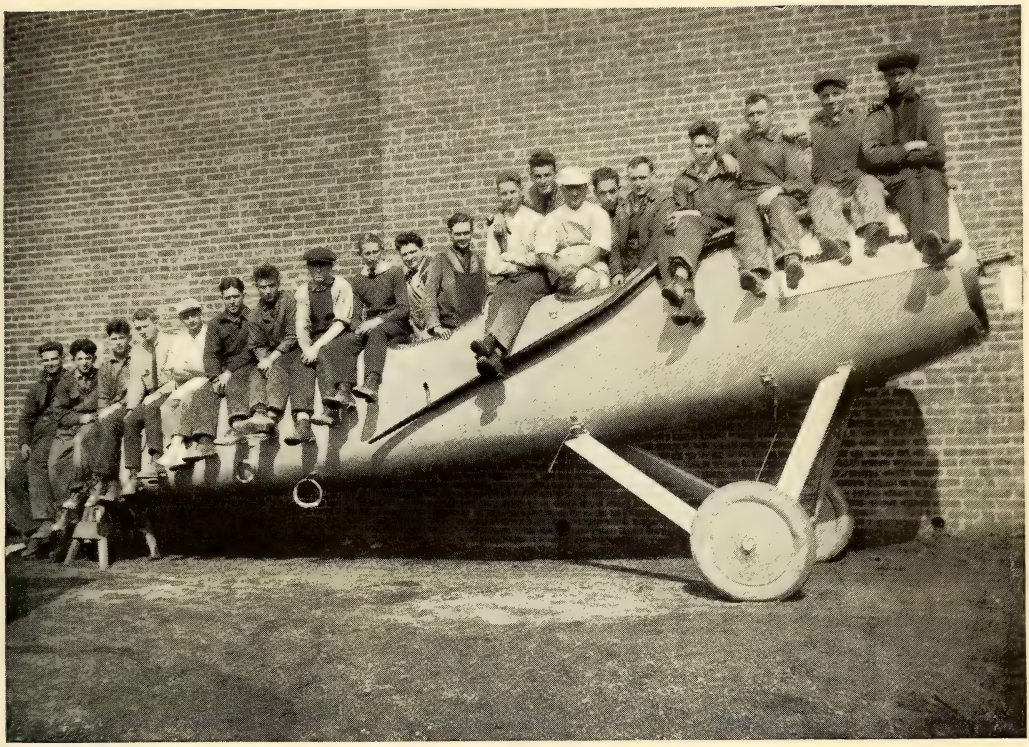
sources of the nation, and the ingenuity and enterprise of our people, the selection and training of a matchlessly skilled and intrepid personnel to man our sky fleets when they are completed present problems of perhaps even greater intricacy. The task of providing men has required not so much a broadcast recruiting as a careful, intensive selection among various isolated classes of specialists and the upbuilding of nearly a dozen courses of training as widely different as black is from white.

We are apt to think of the air service only in the terms of aviators, little realizing that for every aviator there must be nearly a score of other men—psychologists, factory inspectors, photophysicists, welders, expert enginemen—and so on down through a long list. All such men are truly specialists; they are scattered very thinly through society, but must be sought with the utmost care and given a specialized course of training to adapt their present skill to the intricacies of aircraft work.

NEEDS DIFFICULT TO FORESEE

Needs for such men are most difficult to foresee at a glance; in fact, they are apt to become suddenly evident as the situation unfolds. One day, for instance, the Equipment Division will complete its analysis of requirements and put in a request for several thousand trained factory inspectors, vitally necessary to approve the material purchases of about $350,000,000 entrusted to this division. Obviously, this is difficult, painstaking work, requiring the selection of men of experience from a field not very large.

Photophysicists may be the next necessity—fast news photographers trained in the speed of journalism and able to convert a plate from an airplane into a print ready for the General Staff within ten minutes' time. They must be almost hand-picked from the newspaper offices of the country, creating indeed a void here, but at the same time becoming the only authorized photographers of all Uncle Sam's military operations, both for



LIGHT AND TRIM, BUT TOUGH AS STEEL

The strain of twenty men seated on this eggshell of an airplane body is not nearly so great as the tremendous tension caused by a many-horse-powered motor driving the machine through the air at twice or three times the speed of an express train.

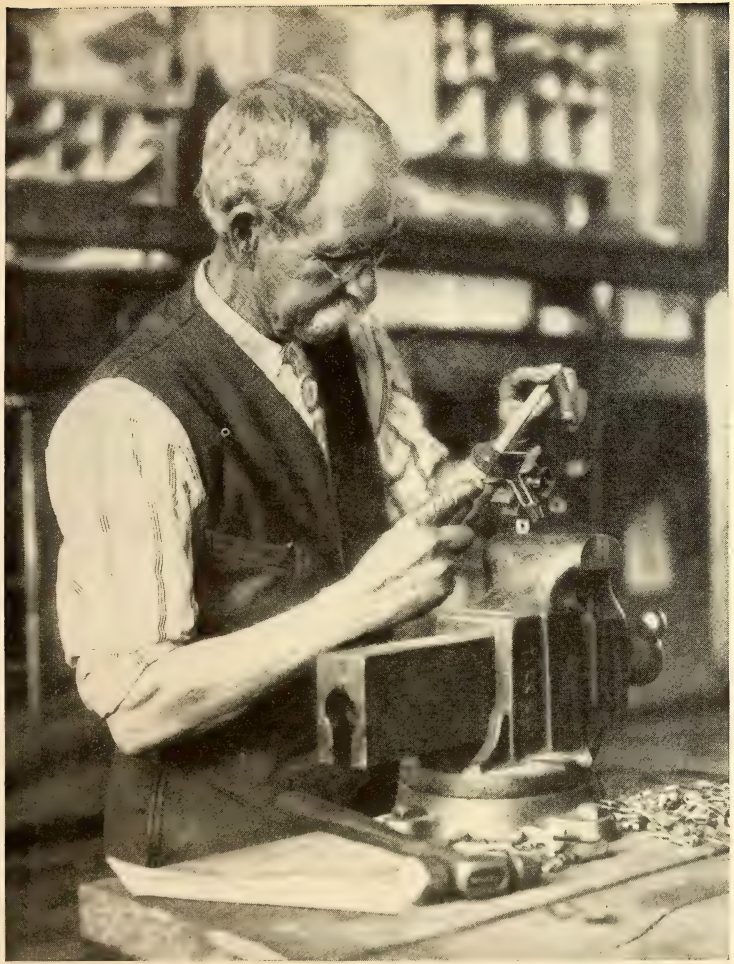
immediate public distribution and for "The Official Pictorial History of the War."

Then comes the need for psychologists, doctors, dentists, and pharmacists. Few people realize that the air service must have its own medical staff, first, because our new flying fields are in themselves large communities subject to the ordinary sicknesses, and, second, because a most careful check must be kept by a skilled physician against the nervous wear and tear of the service. Some aviators who might slowly burn themselves out by too steady concentration are saved by watchful attention to the first signs of weakness.

LIFE OF AN AIRPLANE ENGINE ONLY 100 HOURS

Very possibly the Squadrons Sections will suddenly state a need for several hundred mechanical engineers to carry through all the intricate oversight of planes in the field. We little realize that the life of an airplane engine, for instance, is hardly over a hundred hours, and that the continual substitution of new parts, a few at a time, often entirely remakes it. Indeed, for every plane and engine which we ship to Europe we must ship approximately 70 per cent of spare parts for repairs. The judgment as to when new parts shall be put in is the answer to the life of the plane and must be entrusted only to expert engineers.

Even more difficult, on account of the very much larger number involved, has been the supplying of skilled mechanics—men who can take an engine or a plane apart and put it together again; men skilled in such work as engine-fitting, welding, propeller-making, magnetos, wing construction, lithography, vulcanizing, and the like. It has been necessary to seek them out oftentimes in the byways of industry, in small boat companies, for instance, where are found men ideal for woodworking, or in garages throughout the country, where are found



Photograph by Kadel & Herbert

EACH SCREW MUST BE TRUE, EVERY BOLT MUST BE STRONG, IF AMERICA'S ARMADA OF THE AIR IS TO ACHIEVE VICTORY AND PEACE

One of the most delicate operations in the manufacture of airplanes is the making of metal fittings for the fuselage (the body of the car).

Potograph by Western Newspaper Unior

PAINTING THE DISTINGUISHING STAR ON THE WINGS OF AN AMERICAN AIRPLANE

In order to be readily discernible at high altitudes, the emblems on the wings of the fighting planes of each nation must be as large as possible. The American star, in this instance taller than the man who is painting it, is white on a blue field. The center is red. For the aircraft emblems of other countries see NATIONAL GEOGRAPHIC MAGAZINE, Flag Number (October, 1917), page 319.

AN AVIATION SCHOOL MACHINE FLYING OVER BISCAYNE BAY, FLORIDA

Speed, handiness, and great climbing ability are three essential qualities in a warplane. A machine admirably constructed for fighting at low altitudes but ineffective at an elevation of two and a half miles would be worthless, for in modern air battles it frequently happens that the scene of conflict is four miles above the trenches. The quality which a fighter most values in his machine is "handiness," of which speed is one of the chief factors.

© International Film Service

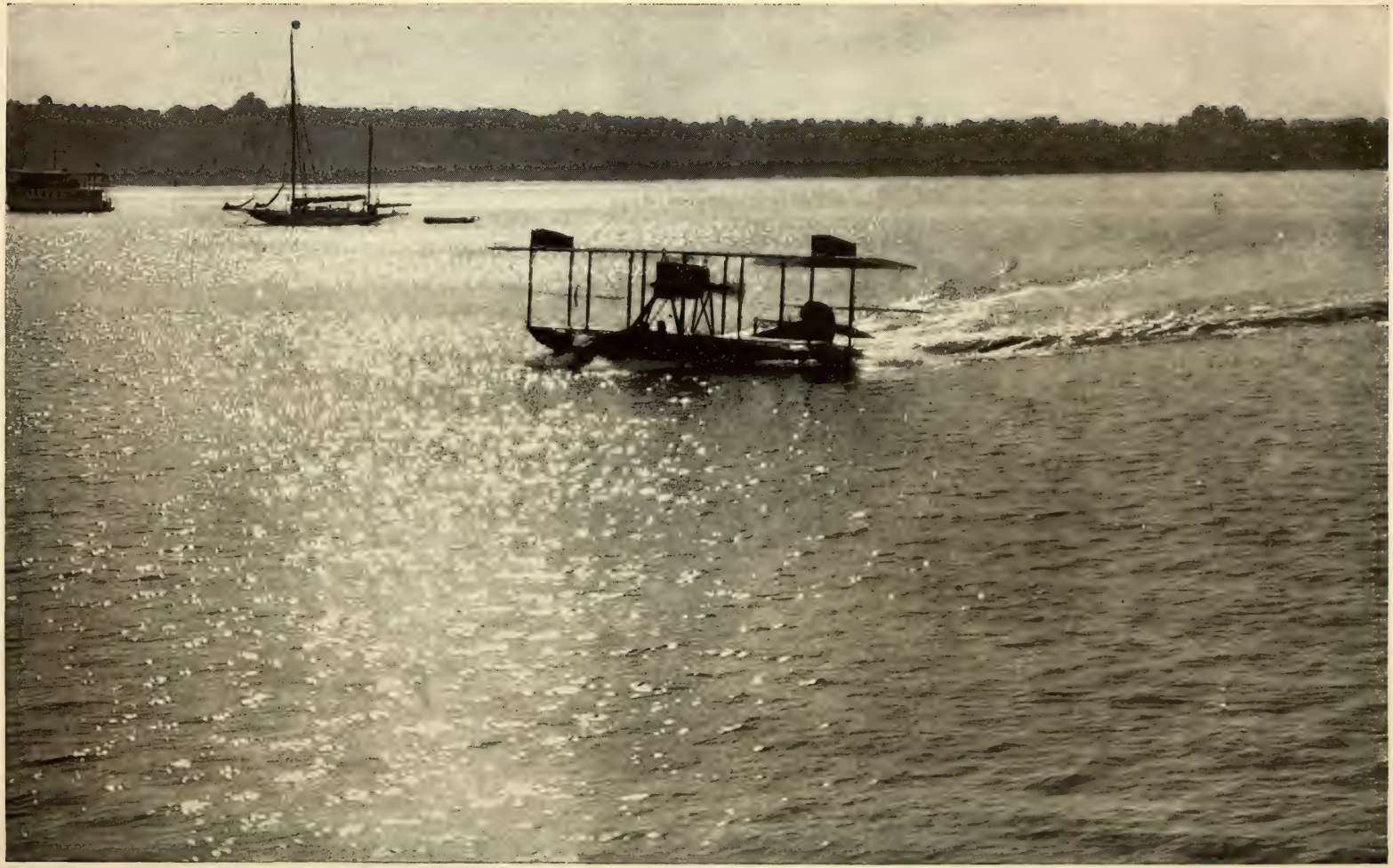
BOAT-HOUSE AND LAGOON AT THE GREAT LAKES TRAINING STATION

In training aviators for the war necessities of the hour America is also providing for the days of peace, when the airplane will play an important rôle in national and international commerce. Many questions remain to be solved—rules of the air, as compared with rules of the road and of the sea; the right of landing; the mapping of air currents; the collection of customs on airplane freight which may be deposited in any part of the country after a flight over international boundaries.

Photograph by Edwin Levick

MINEOLA CAMP MILITARY AVIATION SCHOOL

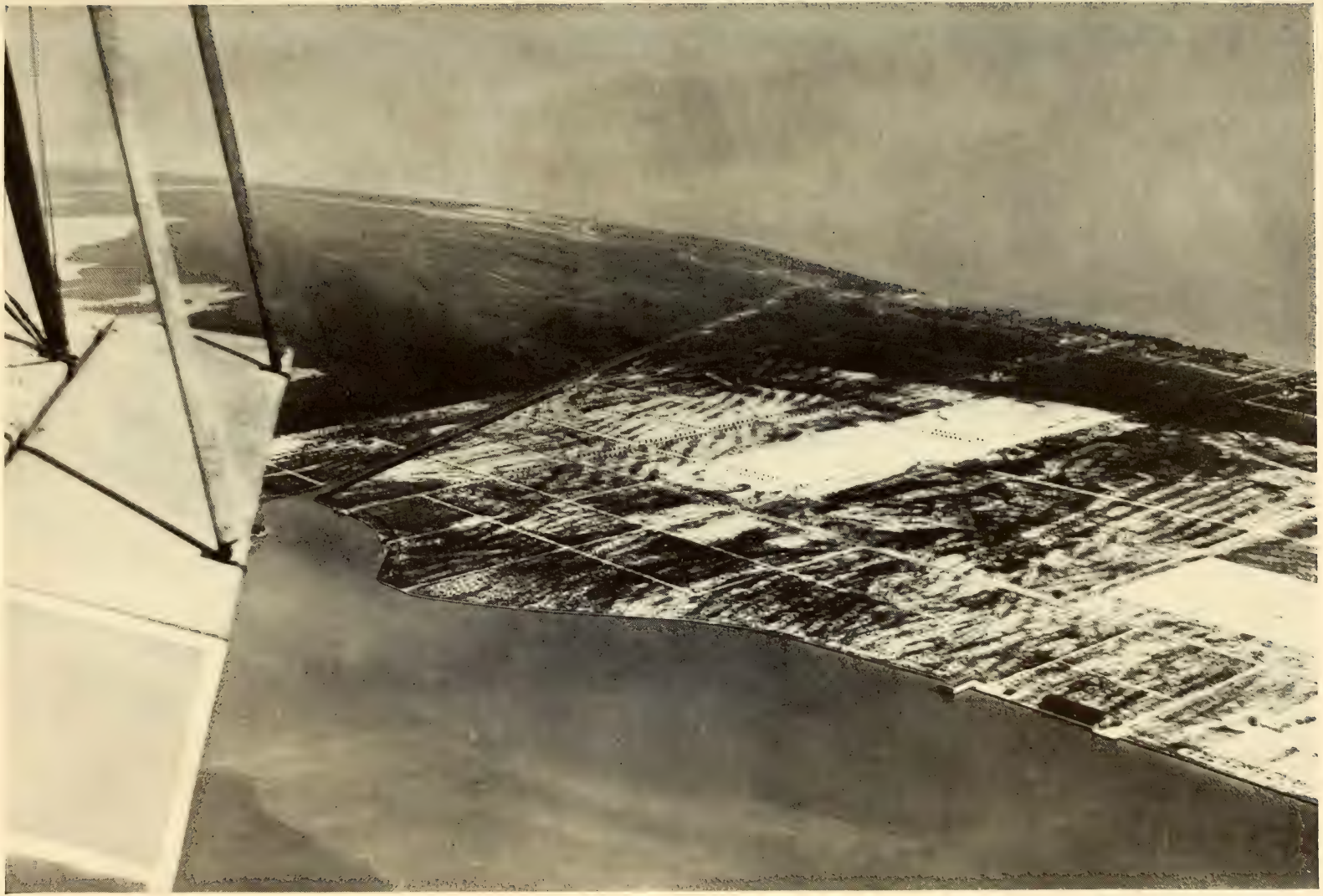
American fliers are in training not only in this country, but also in Southern France, and in a short time the red-white-and-blue star, distinguishing symbol of the United States military airplane, will be "clipping the corners of the pyramids," as our student airmen have been invited to use Great Britain's splendid flying school in Egypt, where the weather conditions are ideal from December to December.



Photograph by Edwin Levick

A HYDRO-AIRPLANE RETURNING TO ITS HANGAR: PORT WASHINGTON, LONG ISLAND

The amphibious machine is a comparatively recent development of man's newest weapon of war. It will be one of our most important instruments of national defense in the years to come, however, if the proposed program of aërial coast patrol is developed.



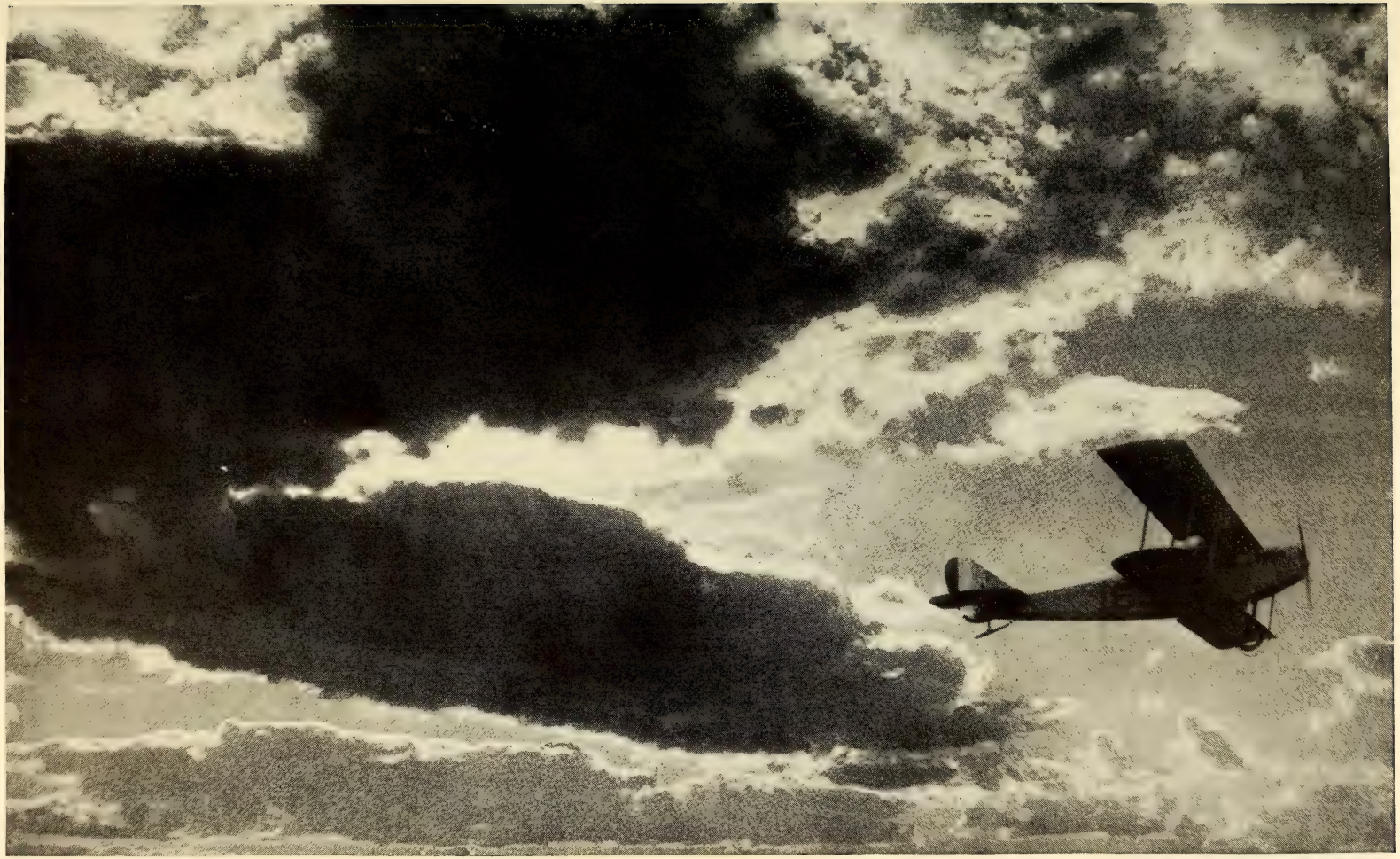
Photograph by R. B. Hoit

AN AËROGRAPH OF ALTON BEACH, FLORIDA, LOOKING TOWARD THE ATLANTIC: PICTURE MADE FROM AN AIRPLANE SOARING OVER BISCAYNE BAY

© Underwood & Underwood

NOT A NOSE DIVE BUT A LOOP-THE-LOOP OVER NEWPORT NEWS, VIRGINIA

The biplane is being operated by an instructor of U. S. Army fliers. This remarkable photograph was made from an airplane soaring hundreds of feet above the black flier in the foreground.



Photograph by Edwin Levick

OUT OF THE STORM

The most dreaded Nemesis of the cadet aviator is a "dead hole" in the air—an area of extreme low pressure caused by ascending and descending currents. When a plane reaches one of these spots it drops like a plummet. Dead holes abound in summer-time up to a height of 1,000 feet, and on extremely hot afternoons they have been encountered at elevations of a mile. They are much less numerous on winter days, and are practically non-existent at night; so that night flying is safest, so far as "holes" are concerned.

© Paul Thompson

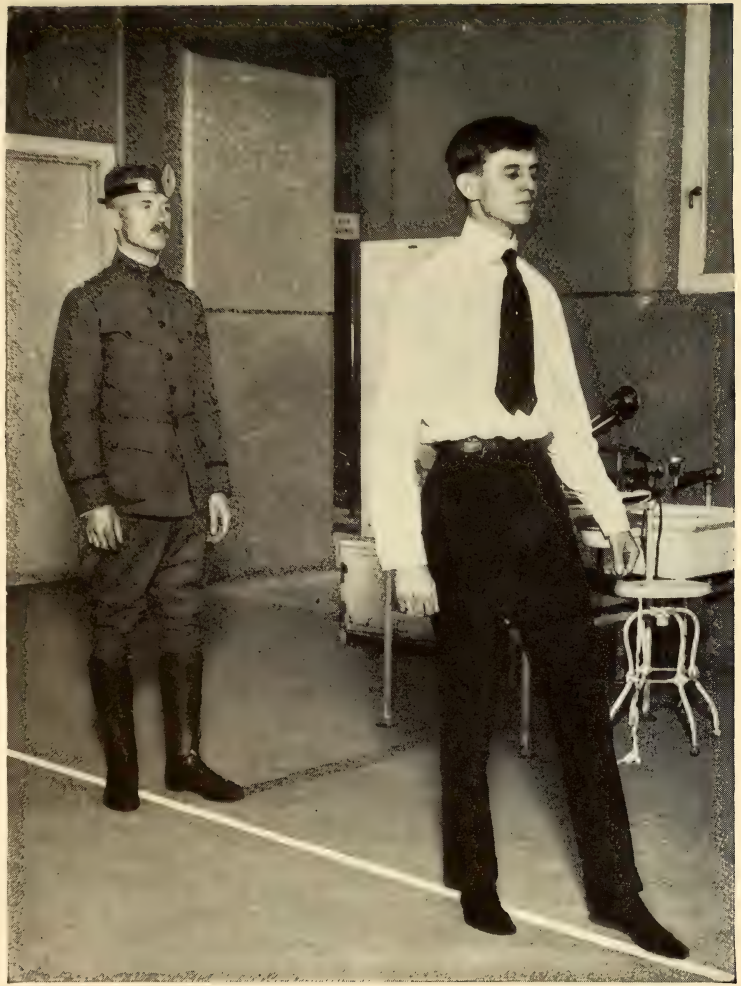
AN AIRPLANE OBSERVER WHO COULD NOT PASS THE STEREOSCOPIC VISION TEST WOULD BE A LIABILITY

It is essential for the airman to be able to judge correctly whether one object is nearer than another; whether one machine is higher than another; whether one battery is further advanced than another. Otherwise he could not direct artillery fire accurately, nor could he protect himself against the attack of enemy aviators.

© Paul Thompson

THE MAN WHO SEES DOUBLE IS NOT DESTINED TO BECOME AN AIR PILOT

In the muscle balance test the candidate watches a candle flame through a peculiar contrivance. The examiner gradually adjusts the apparatus, causing the flame to appear double, one above the other. A spirit-level indicates the point at which the flame should appear duplicated. This is one of the most important tests.



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MAKING THE AVIATION CANDIDATE WALK A LITERAL CHALK-LINE

With eyes closed, the applicant walks forward and backward. His deviation from the straight and narrow way is one of the determining factors in his acceptance or rejection for service as a pilot of America's great air fleet.

© Paul Thompson

PUTTING THE AIR PILOT CANDIDATE THROUGH THE "NYSTAGMUS TEST"

With eyes closed, the applicant, seated in a revolving chair, is whirled around ten times in twenty seconds. The chair is then stopped and the applicant is told to focus his eyes on a distant object. The visual disturbance which results from the whirl is known as the "nystagmus."

© Paul Thompson

WHERE THE MEDICAL EXAMINER USES A STOP-WATCH INSTEAD OF A STETHOSCOPE

After a whirl in a revolving chair, each candidate for America's flying service is tested to see how quickly he recovers his equilibrium. The eyes are the index to man's balancing apparatus.

© Paul Thompson

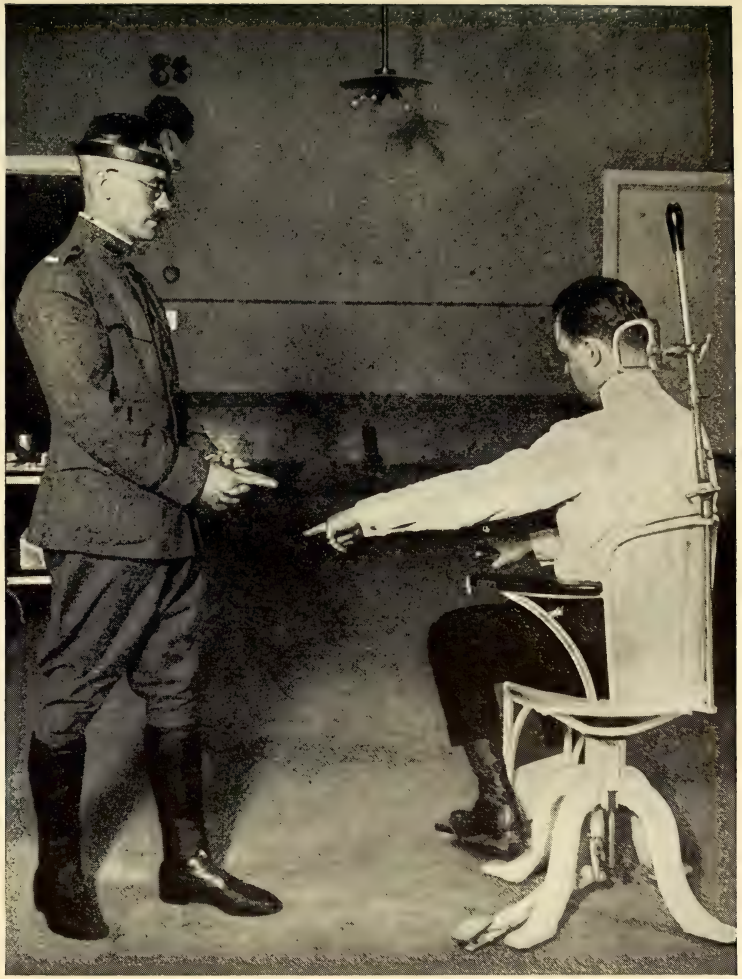
SUBJECTING THE PROSPECTIVE AMERICAN AIRMAN TO THE FALLING TEST

The sixth sense—that of equilibrium—is a function of the labyrinth of the internal ear. One part of the labyrinth consists of three semicircular canals, set in different planes. Through these flows the endolymph, a fluid which acts like a spirit-level.

© Paul Thompson

A CANDIDATE WHO IS RESPONDING NORMALLY TO THE FALLING TEST

With his head forward and eyes closed, the candidate is placed in a spinning chair, which is revolved five times to the left in ten seconds. When the chair stops the candidate is told to raise his head and open his eyes. If he is normal his head will drop to the left, showing that the canals of the inner ear function properly.



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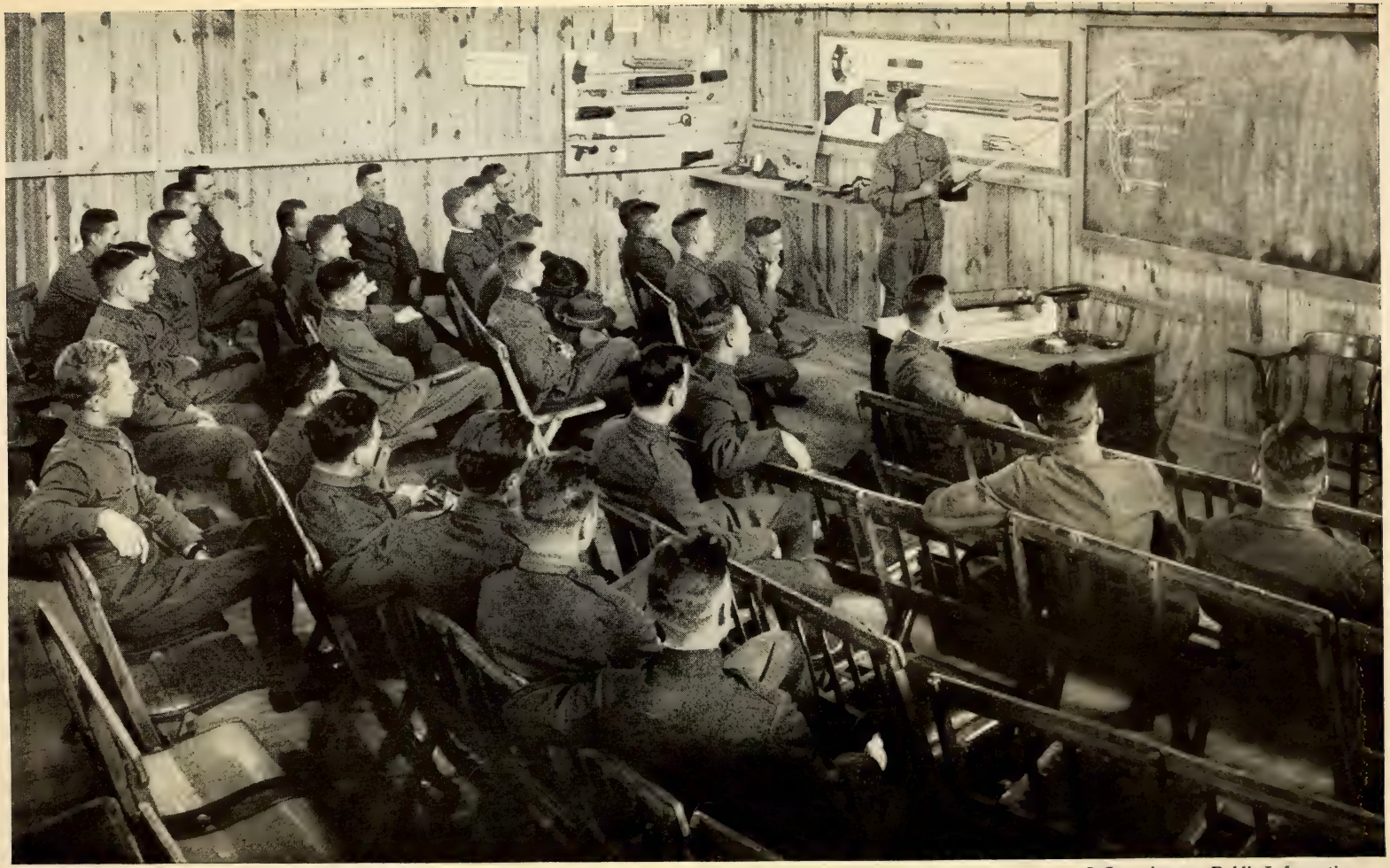
THE "PAST POINTING" TEST TO DETERMINE ONE'S SENSE OF BALANCE AND DIRECTION

The candidate, eyes closed, is trying to touch the examiner's hand with his left forefinger after being whirled ten times in ten seconds. When the chair stopped, the candidate raised his left arm and with eyes tightly closed dropped his arm and "past pointed" to the right, away from the examiner's hand in a sweeping arc.



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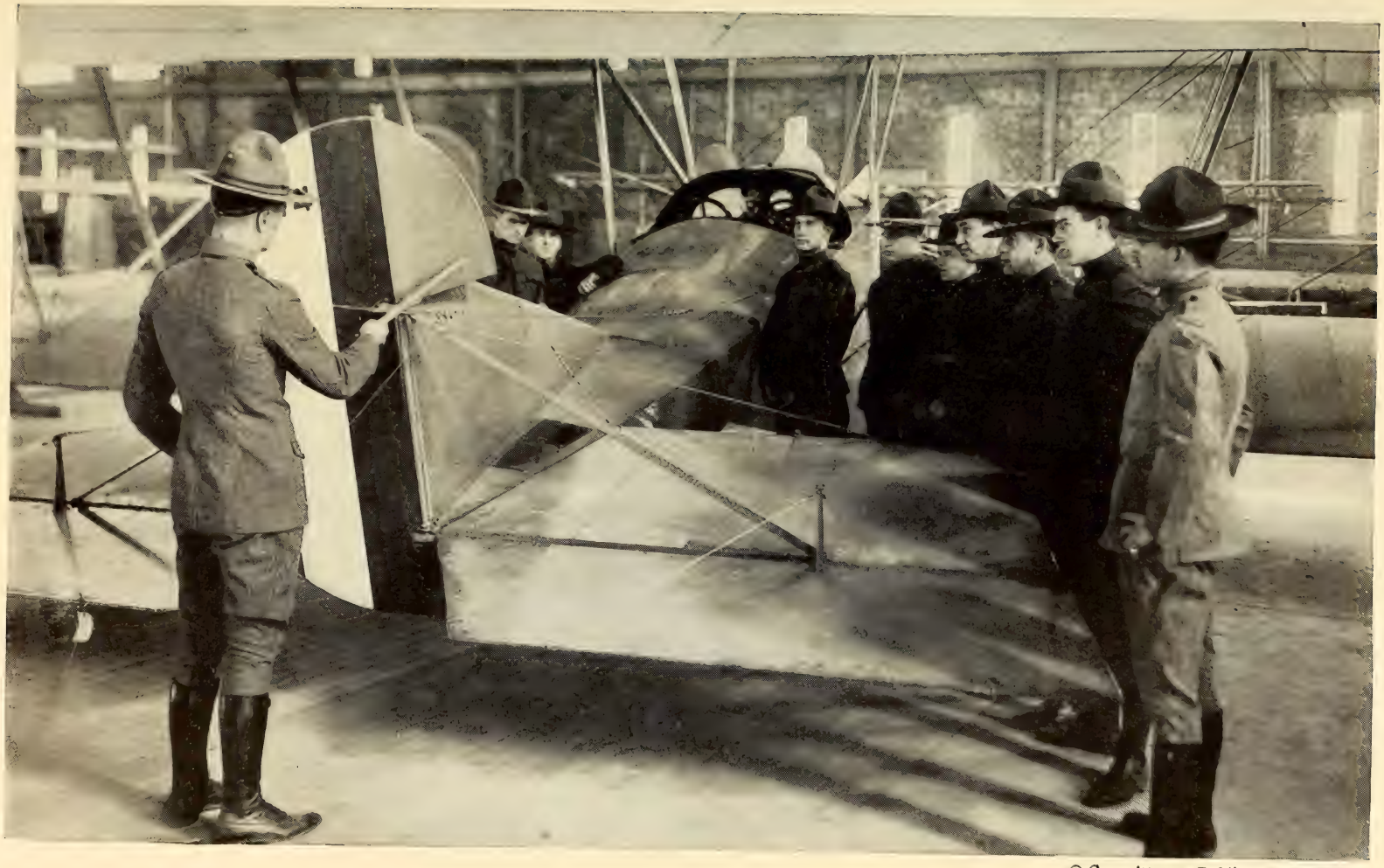
STUDYING THE ANATOMY OF A MACHINE-GUN

These husky lads are preparing for the day when they will become America's golden eagles of the air. From their vantage point in the air they will watch every movement of the enemy. The far-flung battle line will stretch beneath them, with men appearing as ants, serried rows of trenches as mud-cracks on the face of the ground, and the dazzling flashes of big guns but as the feeble coruscations of a firefly on a distant hill. The earth will appear to them as but a map in slight relief, the green betokening the grass field, the yellow the ripening grain, the dark patches the woods, the mirror-like gleam a river or a lake, and the white ribbons the macadam road. And the two streaks of thin brightness are the traffic-polished surfaces of the rails of a railway to the front, stretching across the picture as though ruled by some mighty pen.



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STUDYING THE MYSTERIES OF FLYING

It is impossible to tell how much the armies at the front owe to their aviators. In days past it was the cavalryman, wounded and galloping across the country, mayhap with a thousand foes at his heels. Today there comes flying across the heavens a resolute young hero on the wings of a modern Pegasus, defying shot and shell alike, and enabling his commander to see what Wellington always wanted to see—"what was on the other side of the hill." With an adequate air service for army and navy and the enemy must play his war game with his cards on the table. He has no chance whatever under these conditions to make capital of the element of surprise.

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AVIATION STUDENTS GETTING ACQUAINTED WITH THEIR AIRPLANE ENGINES

It has been said that a first-class mechanic is worth more to a training school than a first-class pilot, and it has been found that they are harder to recruit; yet every pilot must know his engine. He must know by its rhythm when it is running properly; he must have keenness of ear for any unusual sound, for such sounds are danger signals, which, observed in time, may save a machine and its precious freight. Hence, at the training schools every pilot is given the most thorough training in the care of his engine.

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STUDENT AVIATORS MASTERING THE INTRICACIES OF THE AIRPLANE MOTOR

Upon his knowledge of his machine and his ability to make a hasty temporary repair under fire may depend the life of the airman and the information which he has gathered for his commander. It behooves him, therefore, to be a master mechanic as well as a daring fighter.

practical enginemen. The need for this sort of men has not now been filled and very likely will not be as long as the war lasts.

The troubles do not end with their enlistment, however, for all of them must be given a special training to adapt their skill to the peculiar problems of airplanes. Here the government has had splendid coöperation from private plants, which have admitted many such men for a short period of practical instruction.

AN ADMINISTRATIVE PERSONNEL MUST BE TRAINED

All this force when organized into squadrons will require a considerable administrative personnel which we are little inclined to have in mind in thinking of the air service. Adjutants, supply officers, and disbursing officers must be secured from among men of executive ability and trained to the peculiar problems of military procedure, purchasing, hygiene, law, and the like, in order that

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WORK AT A "GROUND SCHOOL"

A knowledge of flying, such as the Western Front requires, is not to be gained merely by flight. Cadets at a "ground school" are shown here assembling the parts of an airplane, one means of acquiring familiarity which will make the operation of it intuitive.

© Committee on Public Information

TRAINING FOR OBSERVATION WORK AT THE FRONT

The aviation students, seated above the platform with their maps in hand, are being drilled in the art of reporting artillery fire at the front. Below is a landscape drawn to scale, and appearing exactly from their perches as if they were in an actual airplane 6,000 feet above the ground the landscape represents; and while they look down on the stretch of territory thus represented the instructor below makes various-colored lights, representing various kinds of artillery fire, according to a schedule as to order and speed. The students make full note on their own maps before them of the location of the shots and prepare the radio messages they would send were they at the front. These are checked up and the poor observers are weeded out, so that only the best men continue on to the front.

Photograph from Collegiate Balloon School

ADJUSTING THE VALVE OF AN OBSERVATION BALLOON BEFORE ITS INFLATION WITH HYDROGEN GAS

the squadron as a whole may become a smoothly running unit of the larger service.

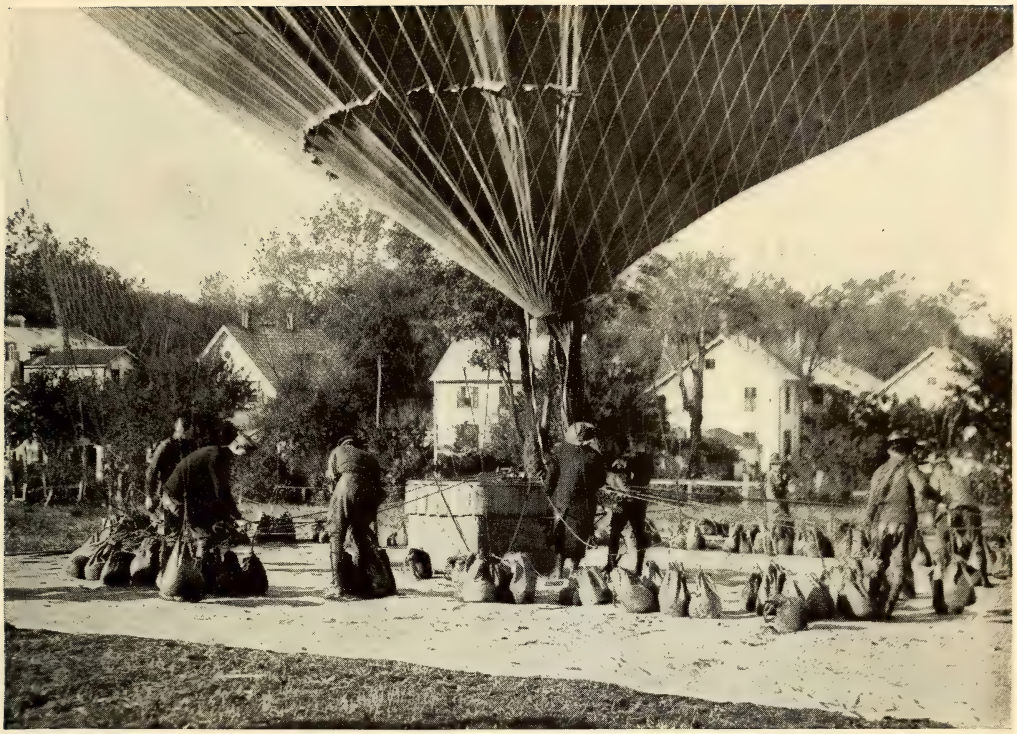
So, too, men for work as observers and bombers to accompany all aviators except the individual fighters have had to be most painstakingly selected from men possessing the two-sided physical and mental requirements necessary and in a proportion of three to every five aviators. The best ages have been found to be from 25 to 35; but as the reports of these men will dictate the movements of whole army corps, it has been necessary to put them through a special eight-weeks' course of instruction to test and develop their keenness of vision, power of deduction, and ability in machine-gunnery, map-reading, and aërial reconnaissance.

Last, before coming to the aviators themselves, is the twin service of the balloonists. This question has presented peculiar problems and has made necessary a two-months' course of training in meteorology, gases, observation, instruction, and flying. The balloonist, while not so spectacular as the aviator, is only less important, for with his range of vision of eight miles and his constant telephonic communication with the ground, he is able to keep a most accurate time schedule of every enemy movement and a detailed record of all gun-fire. For hours at a time he rides calmly and patiently, a mile in the air, noting details which the longer-winged, but more cursory, aviator may overlook.

MANY SPECIAL COURSES OF INSTRUCTION

All these demands for all these different kinds of men have put Uncle Sam into the business of instruction in a way that we little imagine. Special courses have had to be built up, in addition to those of the flying fields, for observers, for bombers, for balloonists, for radio experts, for photographers, for administrative officers, and for enlisted men, each solving entirely new difficulties raised by the new sciences in aviation and the adaptation of old sciences.

So far, then, we have seen the need of an intensive and specialized selection of men for the various collateral work con-



© Underwood & Underwood

ADJUSTING SAND-BAG BALLAST PREPARATORY TO THE ASCENT OF A CAPTIVE BALLOON

While not as spectacular as the aviator's work, the aëronaut has an important rôle in the "economy" of war. The information which he is able to obtain from his perch among the clouds often saves the lives of thousands of his fellow-soldiers who otherwise would be sent, unsuspecting, within the range of some battery cleverly concealed from observers stationed on the ground.

nected with flying. Perhaps a truer perspective of the picture could be derived from this angle than from that of the aviator. Nevertheless, so much romance and popular interest attaches to the latter that a brief outline of his career would be valuable.

The difficulty in securing aviators is not in securing enough applicants, but in securing the right kind of applicants. It is too obvious for statement that the man who is to fly several miles above the ground and upon whose reports may depend the fire of half a dozen batteries, the shifting of the steel wall of the barrage, even the success of the whole battle, must have a peculiar combination of both physical and mental attributes.

Some criticism has arisen as to the severity of the tests; but let it ever be remembered that a poor aviator has all the power of harm that a good aviator has of good. Hundreds of applicants obviously unfit have had to be turned away, both for their own good and for the good of the service, but that most emphatically does not mean that a good man is not just as vitally, indeed more vitally, needed than ever.

A SENSE OF RESPONSIBILITY IS VITAL

The whole emphasis of the service now is to secure men who, besides perfect physique, have a full sense of the responsibility of their work to the men below. An aviator sent to get a photograph, investigate an emplacement, or drop bombs has no other business. He must carry out his orders and, particularly, must avoid jeopardizing himself and his machine unnecessarily. The air service today is an earnest, responsible science, where stunts have their place only as a means to carry out a larger mission and where "dare-devils" and circus performers must give way before the real teamwork of the air.

Certain special physical qualifications

Photograph from Collegiate Balloon School

READY FOR A "SOLO" FLIGHT

This type of observation balloon has one serious disadvantage: when held captive it oscillates in the slightest breeze, making it difficult for the observer in the car or basket to take accurate note of enemy movements and day-to-day changes in fortified positions back of the front-line trenches.

are, of course, fundamental. The prospective avatior is probably not surprised when his chest is tapped by the medical examiner, when he is asked to expand his lungs, and when his arm is bound in a tight rubber band to test his blood pressure. Similarly, the testing of the nose and throat to guard against any obstruction in ventilation which might cause vertigo or nausea may be unexpected, but not startling, to a man who expects to go through the aviator's wide range of temperature and atmospheric pressure. The Jennings self-recording color-sense tester probably appears only a little unusual, for it is realized that perfect vision is essential to observation work from the clouds, and that any defect of vision might prove fatal in a sudden emergency.

The balance test, however, will prove a distinct surprise, for few people realize that the sense of balance is controlled by a fluid which flows back and forth in the labyrinth of the inner ear, just as the fluid in a spirit-level flows back and forth. To set this fluid in motion and see how quickly it reacts, the candidate is seated in a revolving chair which is spun rapidly around. When it is brought to a stop, the candidate is asked to point out certain objects, his visual disturbance is noted, and a pretty good estimate is made as to whether he could bring himself out of a spiral or right his machine after a falling-leaf evolution.

THE MENTAL EXAMINATION IS NOT FORMIDABLE

Next comes the mental examination, not nearly so formidable as the phrase implies. Its purpose is to find out from the candidate's records, from his history, education, athletic ability, and general presence whether he has the alertness, aggressiveness, accuracy, and sense of responsibility desired. A good aviator should be neither all brains and no physique nor all physique and no brains, but

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FOUR "SAUSAGE BALLOONS" AND A DIRIGIBLE FLYING OVER AN AMERICAN AËRONAUTICAL TRAINING STATION

Airships and balloons are known in the slang of the fighting front as "gas-bags." In the British service they are frequently called "S. S.'s"—Submarine Seekers.

should combine the two in an all-round ability.

If accepted, the candidate becomes a "flying cadet." That status he holds throughout his course of training until he passes his reserve military aviator test and receives his officer's commission. Technically he is enlisted in the Signal Enlisted Reserve Corps at a salary of $30 a month, with quarters, uniform, and food allowance of 60 cents daily provided by the government. At any time, of course, he is subject to discharge if it is obvious that he is mentally or morally unqualified to become an aviator.

His first assignment is to a "ground" school at one of the eight large engineering universities working in coöperation with the government. Here there is action and interest at once. In company with several score other physically fit and eager men, in an atmosphere of earnest work, the principles of the sciences he intends to master are unfolded.

During these crowded eight weeks he secures a basic instruction in the principles and theory of flying, radio work, codes and photography, the operation and care of airplane engines, planes, and machine-guns, and the theories of coöperation between the air service, the infantry, and the artillery. He is also given pri-

Photograph by Central News Photo Service

ON GUARD ABOVE A BATTLESHIP AT ANCHOR IN HOME WATERS

An important advantage which the airplane or captive balloon enjoys in the rôle of a lookout is the fact that an observer high above the sea can easily detect the shadowy presence of a submarine beneath the waves, whereas the sinister craft may be entirely invisible to one on the deck of a threatened warship.

mary instruction in meteorology and astronomy and devotes considerable time to military drill and calisthenics. From reveille, at 5.30 a. m., to tattoo, at 9.30, there is serious and interesting work.

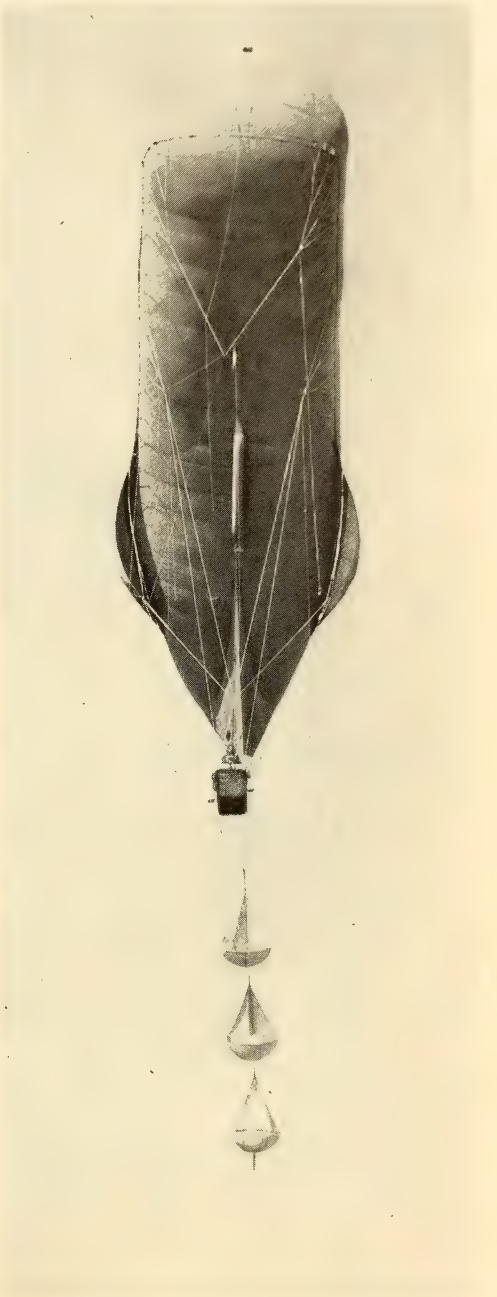
The next step is to one of the great new flying schools, where instruction in actual flying is given. First comes the dual work with the instructor, beginning with long "hops" into the air and down again, to accustom the pupil to the various controls, such as the rudder, elevator, throttle and switch, and to the general "feel" of an airplane. Baffling enough at first, mastery of this work affords an instinctive control of the machine, so that whatever happens later he will not lose his head and make the wrong move.

WHEN THE CADET FIRST FLIES ALONE

Gradually, as the cadet's skill and confidence increase, he is given increasing responsibility for the machine, though the instructor remains with him to save him from a slip. When at last he has demonstrated absolute control of himself and his plane, he is ready for the third stage, the proud moment when he leaves the ground alone. He is held back, however, rather than hurried forward into this, on the theory that it is far better to spend a few extra days in intensive instruction than it is to lose either a cadet or a plane, both of which are now part of America's air capital. The infrequency of fatal accidents in America's great training program has more than justified this caution.

The next stage is known as solo work, or flying alone. Backed by the fundamental training of the ground school and the dual instruction, the cadet is fully qualified to take the air by himself. His every move is noted and suggestions for improvement given on his return to earth. Gradually, he is allowed to lengthen out the distance and the height of his flights, until he is easily executing 30-mile cross-country trips and the simpler evolutions at an altitude around 10,000 feet.

By now he has completed the requirements for his designation as a "reserve military aviator," which automatically carries with it his first commission, that of a second lieutenant, with a salary of $1,700 a year. How long it has taken



Photograph by Central News Photo Service

A KITE BALLOON ON OBSERVATION DUTY OVER AN AMERICAN WARSHIP TO WHICH IT IS ATTACHED

The three round-bottom cones are air anchors, which serve to keep the basket of the observer stable and facilitate his careful watch for submarines. These canvas stabilizers constitute the tail of the kite balloon.

depends on his skill, his adaptability, and his attention to discipline.

THE POST-GRADUATE COURSE IN FRANCE

The finishing touches of the training still remain, however. These are given in advance schools in France, and comprise the more complex evolutions in the air and tactical movements by wings and squadrons. By the end of this course he is complete master of the air, is able to spiral, side-slip, execute the falling-leaf, and handle radio, photography, or machine-gun, a fully trained member of Uncle Sam's new army, entirely at home in this new element.

Thus is the great personnel of America's air service mainly built up; so is the appeal of the Allies being answered, to furnish them with an unequaled force of men; for if there was one thing that was hoped for when the United States entered the war, it was that we should make from our rich resources of fearless, adventurous, and quick-thinking young manhood a trained air personnel to fill the places of that corresponding class of men among the Allies, many of whom had been ruthlessly killed off in the trenches before the true place of aviation was realized.

THE LIFE STORY OF AN AMERICAN AIRMAN IN FRANCE

Extracts from the Letters of Stuart Walcott, Who, Between July and December, 1917, Learned to Fly in French Schools of Aviation, Won Fame at the Front, and Fell Near Saint Souplet

STUART WALCOTT was a senior at Princeton University in the winter of 1916-17. In view of his approaching graduation in the spring, his father wrote to him that he had best begin to think about what he was to do after graduation, in order that he might get on an independent basis as soon as practicable.

In response, under date of January 7, he wrote:

"You spoke of my being independent after I graduated in the spring. If I go to Europe, as I want to, to drive an ambulance or in the air service, I will be doing a man's work and shall be doing enough to support myself. If the work is unpaid, it is merely because it is charitable work and as such is given freely.

"If you want to pay my way, I will consider it not as dependence on you, father, but as a partnership that may help the Allies and their cause. I will furnish my services and you the funds to make my services available. If not, I will be willing to invest the small amount of capital which has accumulated in my name.

"I have been thinking of this work in Europe for over a year now and am still very strong for it. I don't know what the effect will be on myself, but if it will be of service to others, I think that it is something I ought to do."

Being assured that the expenses would be provided for, he then began an investigation as to the best method of procedure to obtain training as an aviator.

BELIEVED THE AVIATOR OF GREAT SERVICE TO HUMANITY

In a letter dated January 26 he said:

"Many, many thanks for sending me the book on the French Flying Corps, by

Winslow. I read half of it the night that it came and stayed up late last night to finish it. He gives a very straight, interesting, and apparently not exaggerated account of the work over there, which has made somewhat clearer to me just what it is that I want to get into. Now I am even more anxious than I was before to join the service over there.

"The more that I think about it and the more that I hear of it, the more desirous I am of getting into the Flying Corps. If a man like Winslow, with a wife and daughter dependent on him, is willing to take the risk involved, I see no reason why I should not.

"You mention the Ambulance Service in your last note. I have thought of that quite a little and would definitely prefer the aviation. The ambulance is worth while, I think, in that it gives one an opportunity to be of great service to humanity, but not so much so as the other. There will be a number of my classmates who will enlist in the American Ambulance Service this spring, but the air service appeals to me."

He then made arrangements with the American representatives of the Lafayette Escadrille to go to France on the completion of his college year.

January 29 he wrote:

"I will get a physical examination in a few days. In regard to getting the training over here first, I do not think that it would be worth while. The instruction over there would be first hand, tried, for a definite purpose, and on the whole superior to what I could get here. I could also be picking up the language and the hang of the country at the same time."

On February 24 he received word that his papers, presented with his application for admittance to the Franco-American Flying Corps, assured him on their face of a welcome when he presented himself in Paris. He was informed that if he utilized his spare time in availing himself of any and every opportunity to familiarize himself with flying, it would shorten his stay in the Student Aviators School in France.

On March 26:

"I haven't been able to find out anything definite about the school at Mineola. As yet, no change has been announced, to my knowledge, in reference to hastening up the course in event of the coming of war. Over a hundred men have left college (Princeton) already to start training for the Mosquito Fleet and the rest of them are drilling every afternoon.

"What do you think of the advisability of stopping college and going to some aviation school? Considering that it takes several months to become at all useful as an aviator and that war is practically inevitable now, I think it would be wise to get started right away."

ANXIOUS TO LEARN FRENCH METHODS OF FLYING

In a letter of April 3:

"I saw in the morning paper that the American flyers in France would be transferred to American registry immediately after the declaration of war. When you next see General Squier, I wish that you would sound him on the probability of a force being sent to France to learn to fly according to French methods. That is the one thing above all others that I want to get into. If there is any chance of that I do not want to get involved in anything else. . . .

"It is quite certain that seniors who leave college now, to go into military work, will receive their degrees. I would not object to losing the work, as it is not my present intention to keep on with theoretical chemistry, and that is what I am devoting my time to this spring. From the standpoint of education alone, I think that my time could be more profitably spent in the study of aviation."

Leave was granted by the university, and on April 6 B. Stuart Walcott was appointed a special assistant to Mr. Sidney D. Waldon, inspector of airplanes and airplane motors, Signal Service at Large. He immediately reported to Mr. Waldon and worked with him through April. May 1 he went to Newport News, Virginia. May 2 he reported:

"My first trip up was this afternoon with Victor Carlstrom. We were out 16 minutes and climbed 3,500 feet. It was all very simple, getting up there—a little wind and noise and some bumps and pockets in the air—a glorious view of the harbor.

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TWO-SEATER AIRPLANES READY TO ASCEND AT ONE OF THE NEW AMERICAN FLYING SCHOOLS

One method of training the student aviator is by means of the dual control machine. The student takes his place as pilot, while the instructor sits behind him. As long as the student is operating the mechanism correctly he is master of the plane, but the moment he makes a false move the instructor, with duplicate control levers, rights the machine and prevents a spill.

"Then we started to come down. First I saw the earth directly below through the planes on the left. Then the horizon made a sudden wild lurch and Newport News appeared directly below on my right. This continued for a little while and then we started down at an angle of about 30 degrees to the perpendicular, turning as we went. I later learned that Carlstrom had executed a few steep banks, or sharp turns, and then spiraled down. It ended with a very pretty landing, following with a series of banks to check speed.

"Flying, from my first impression, is a very fascinating game and the one I want to stay with for a while. I have signed up for 100 minutes in the air. While this 100 minutes will not make me a flier by any means, I think it is well worth the while, in that it gives me a little element of certainty in going abroad. I will know, if all goes well, that I am not unable to fly."

The next day he wrote:

"Two flights this morning; 25 minutes *in toto*. The greatest sport I ever had. Wonderful work. I did most of the work after we got up a safe distance."

Having obtained a certificate of 100 minutes' flight and passed the necessary physical examination, he left for France, arriving at Bordeaux May 31, and soon reported at Avord for training.

WALCOTT'S LETTERS HOME

Escole d'Aviation Militaire,
Avord, Cher, France,
Friday, July 13, 1917.

You see, it's Friday, the thirteenth, my lucky day, and I'm happy because the work is going well. First, I'll tell you about a smash I had a week or so ago.

The roller, or *rouleur,* class which I smashed in has the same machine as those that fly with a 45 P motor. Only it is throttled down, and we are supposed to keep it on the ground—just about ready to fly, but not quite getting up—a speed of about 30 m. p. h.

When there is the slightest wind we cannot roll, because the wind turns the tail around and swings the machine in a circle—a wooden horse—*cheval de bois.* I rode about the end of the list Saturday, and the wind had come up as the day got on. Work stops at 8.30 a. m. always, because there's too much wind.

My first sortie, or trip, went O K, with a considerable breeze on the tail, but on the second there was too much wind, and after I got going pretty fast, around she went. The wind caught under the inside wing and up it went. Smash went the outside wheel and a crackle of bursting wood. All the front framework of wood that holds the motor was smashed—a pretty bad break. The monitor was a bit mad and talked to me a bit in French.

The next morning I was called in to see the chief of the Bleriot School, St. de Chavannes, a very nice officer. He told me that my monitor was not satisfied with me; that he had told me to do something (cut the motor when the machine started to turn) three separate times, and that each time I had intentionally disobeyed; that if anything like that happened again I would be "radiated" (discharged from the school).

That was quite the first I had ever heard of it, and I was so mad at the monitor that I could have kicked him in the head. I tried to explain to the lieutenant, but he never heard a word; so I just gurgled with wrath and didn't do anything. But yesterday we got another monitor, who is a different sort.

The class after *rouleur* is *decollét;* it is the same machine, but one gets off the ground about a meter or two, then slacks up on the motor and settles to the earth. It is strictly forbidden to *decollét* in the *rouleur* class. This morning I had a sortie in the *rouleur,* and all of a sudden noticed that I was in the air a bit; managed to keep it straight and get out of the air without smashing. The monitor said nothing, so I *decolléed* on all the sorties.

When I got out the monitor explained that it was strictly forbidden to go off the ground in the *rouleur* class; that I shouldn't have done it, and then asked me if I would like to go up to the other class. Whereupon, consenting, I am now in the *decollét* class, leaving 16 rather peeved Americans who arrived in the *rouleur* the same time I did, who can perform in the *rouleur* quite as well as I

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AIRPLANES HOVERING OVER THE TENTS OF TROOPS STATIONED AS A GUARD AT AN AMERICAN AVIATION SCHOOL CAMP

The flying machines and other equipment of our future airmen must be watched day and night to protect them from the tamperings of Teuton spies and sympathizers

can, and who will remain in the *rouleur* for some time yet. They've no grudge against me, however, as it was only a streak of luck on my part.

Later in the morning I had some sorties in the *decolleur* and got up 2 or 3 meters. The wind was too strong, so my trips were a bit rough, but nothing was damaged; so hurrah for Friday, the thirteenth.

RAPID ADVANCEMENT AT THE FRENCH SCHOOL

July 17, 1917.

The work has been going very well since last I wrote you, which was only two or three days ago. I told you about at last leaving the blessed *rouleur;* I never was so relieved in my life.

The first evening in the *decollét* class I was requisitioned to turn tails, and the morning after there was too much wind to work. The *decollét* is the one where you go up 2 or 3 meters and settle down by cutting speed. The first time I had three sorties in the wind, bounced around a lot, but did no damage.

The next time was first thing in the morning. Two meters up on the first—four or five on the fifth—strictly against orders. I even had to *piqué*—point the machine toward the ground—a little, which is not at all *comme il faut* in the *decollét.* If I had smashed while doing more than I was told to, there would have been a lot of trouble; as it was, no objection, and the monitor personally conducted me to the *piqué* class with a very nice recommendation.

Now there are two *piqué* classes: one with a *pisté,* about one-fourth of a mile long, in which one is supposed to do little more than *decollét,* get up about 5 meters and *piqué* a *tout petit peu*—hardly at all. After comes the advanced *piqué,* with a much longer *pisté,* on which one can get up 100 meters (300 feet).

On my first sortie in the *piqué,* I was told to roll on the ground all the way; so, continuing my policy, did a low *decollét.* Next I was supposed to do a 2-meter *decollét,* so went up ten and *piquéd.* Had ten sorties in that class one morning, getting as high as I could—about 20 meters—and went to the advanced *piqué* that night—last night. Four sorties there last night with a machine with a poor motor, so didn't get up over 100 feet.

And this morning I did my first real aviating. There was a bit of a wind blowing, so the monitor, Mr. Moses, only let a lieutenant and me go up, as we had gone better than the others last night. First it was a bit rainy and always bumpy as the deuce—air puffs and pockets which require the entire corrective force of the wing warp and rudder to overcome.

My last sortie was decidedly active. The wind had developed into a bit of a breeze, which is to a Bleriot like a rough sea to a rowboat. Two or three times I got a puff that tipped the machine way over—put the controls over as far as I could and waited. It seemed a minute before she straightened. The trouble was that the machine was climbing and therefore not going very fast. If I had *piquéd,* it would have corrected quicker.

ADVANTAGES OF THE BLERIOT TRAINING

I had no trouble at all in making the landing. Hopping out of the machine, I saw the head monitor rushing over to Mr. Moses on the double, shouting volubly in French and berating him severely. I gathered that he had been watching my maneuvers, expecting something to fall every instant, and that he strenuously objected to Moses' letting me go up. Work stopped there for the morning, and it was very fully explained to me what the trouble was. If I have some sorties there tonight, I go to *tour du piste* (flying field) in the morning. I may be on Nieuport in two weeks.

I am now beginning to see the advantages of the Bleriot training. There is a great deal of preliminary work on or near the ground. In all other aviation training, such as at Newport News, 90 per cent of the work is in making landings—in piquéing down, redressing at the proper moment and making gradual connections with the earth.

I haven't made a really bad landing yet, and the reason is that I have been in a machine so much on and near the ground that I have sort of developed a sense or feel of it, and almost automatically redress correctly and settle easily; also I

can tell pretty closely what is flying speed because of the work on the rollers. It's the same way with all the other students, only I know it now from my own experience.

And this morning I began to realize that my 100 minutes at Newport News was invaluable. I not only found out some of the tricks of a master hand (Carlstrom), but also developed a bit of confidence in the air, and air sense, without which I could have gotten into trouble this morning.

My bumpy ride this morning is absolutely invaluable. I'll probably never have so much trouble in the air again, because a fast machine, or even a Bleriot with a good motor, would hardly have noticed those puffs. It was a bit risky, I guess, or the head monitor would not have been worried; but now that it's over I know a lot more.

A FLYER IN A BEAN PATCH

August 25, 1917.

I started for my altitude test three days ago. The requirement is one hour above 2,000 meters. I got to 1,950 meters and one cylinder refused to fire, so I was forced to come down.

The next morning I tried again; got to 900 meters and the magneto ceased to function, thereby stopping all progress. I glided towards home, but didn't have quite the height to make the *piste,* so had to land in a near-by field, just dodging a potato patch. A flock of curious sheep came around and carefully examined the machine, getting mixed up in the wires of the open tail construction and leaving considerable wool thereon.

When the mechanics eventually got the motor going, I started off; didn't get quite in the air before the motor went bad, and then I ran into a bean patch, gathering about a bushel of beans with the same tail wires. Yesterday morning I tried again; climbed to 2,000 in 14 minutes and to 3,500 meters (11,500 feet) in 40 minutes.

I went up through some light clouds, and when I got to 3,500, the top of my recording barograph, more clouds had formed and I was practically shut off from the earth, nothing but a sea of clouds below me—a very beautiful sight. One other machine was in sight, far below me, but on top of the clouds.

Not wanting to get lost, I came down through the clouds and stayed out my hour, just above 2,000 and below the clouds, where the air was very much churned up, keeping me very busy. Just as soon as the time was up I came down, with a pair of chilled feet, making the 2,000 meters in five minutes to the ground. No work since then on account of bad weather.

This morning I attended my first Catholic funeral, that of the commandant of the school, who was the victim of a mid-air collision, a very unusual accident. The other machine got down safely, though badly smashed. Everybody in camp attended the funeral in the chapel of the artillery camp next door. I understood none of the service, but the music by a tenor and a 'cello was excellent. While the cortege was going down the hill to the cemetery, a Nieuport circled overhead very low for half an hour or more and dropped a wreath. It was a very impressive ceremony.

I expect to start on *triangles* and *petits voyages* in a few days. When they are done, I will be a breveted flyer in the French army. Then comes *perfectionne* work and acrobacy; so it will be quite a while yet for me.

THE WILD MAN IN THE NIEUPORT

September 1, 1917

The wild man in the Nieuport was out again this morning giving some one a joy ride. There is a long straight stretch of road in front of our *piste* and he came down that several times, a nasty, puffy wind blowing which bothered him not at all, flying only two or three feet off the ground.

In front of the *piste* is a telephone wire crossing the road. He came along the road 100 miles an hour until almost on top of the wire, and jumped up just in time to clear it by a few feet—really beautiful work. He goes all over the surrounding country flying low, hopping over trees and houses—sometimes turning up sideways to slip between two trees a bit too close together to fly through—

sometimes dragging a wing through the space between a couple of hangars or doing vertical virages just in front of them.

It doesn't seem possible that any man can be so much a part of his machine, can be so consistently accurate that he never misses. For this chap, Lumière, has never had a smash. . . .

A chap named Loughran started off on one of his brevet voyages a few days before I got ready for brevet. He got quite a ways along, ran into a storm, went above it, got caught in a cloud, kept on for quite a long way, being drifted by a strong wind, then came down through the clouds and found that they were only 400 feet above the ground.

After a while he found a place to land and came down safely. He went to a farmhouse, got his machine guarded and tied down. In the meantime, word had spread over the countryside that an aviator had come down there and the entire population came out to look him over.

Photograph by Western Newspaper Union

SUIT IN USE BY THE UNITED STATES ARMY AVIATORS

The airman cannot be clad too warmly. Recently in an altitude flight an Italian aviator, Lieutenant Guido Guidi, encountered a temperature of 89 degrees below zero at a height of 19,750 feet, but he continued to mount another mile.

A grand equipage drove up with a Count who lived in a near-by château. He insisted that Eddie come to the château and accept their hospitality. There the fortunate Ed stayed five days—the Countess talked English, and also some house-guests. He hadn't brought a trunk, so borrowed razor, etc., from the Count—went down to see the machine every day in the baronial barouche.

Whenever he went to the little town in the vicinity, all the kids followed him around the streets; and when at last he left he was presented with a multitude of bouquets and had to kiss each and every donor. He brought back pictures of the château—a delightful-looking old place—and numerous addresses.

THE FIRST CROSS-COUNTRY FLIGHT

September 4, 1917.

At last the two weeks of wind and

Photograph by Edwin Levick

STUDENT AND INSTRUCTING AVIATORS MAKING NOTES OF FEATS OF MEN IN THE AIR

The amount of actual flying time allotted to a student aviator at a training school is comparatively brief. A major portion of his instruction is derived from watching the mistakes of others and in being told how to remedy his own defects, carefully noted by experts while he is "up."

rain has ceased and now it is perfect weather—a bit of a breeze and lots of sun for the last two days. Yesterday morning there weren't enough machines to go around, so I did not work, making the eighth consecutive day I hadn't stepped in a machine.

Last evening I, at last and with much rejoicing, started out on my "maiden voyage" to another school about 60 kilometers away (37.5 miles). It was delightfully easy—nothing to do but climb 2 or 3 thousand feet and just sit there and watch the country unfold, comparing the map-like surface of the earth spread out below with the map in the machine. In good weather it is very easy to follow, spot roads, towns, woods, rivers, and bridges. Railroad tracks get lost at high altitudes and are harder to find anyway.

One has to keep an eye open for a place to land within gliding distance in case of a *panne* always; but the country is so flat and so much cultivated around here that it is absurdly simple. I endeavored always to keep some pleasant-looking house or château in range in case of trouble, for the French are proverb-

ially hospitable to aviators *en panne* (lying to, descending).

Coming back yesterday evening, the sun was pretty low and the air absolutely calm—nothing but the drone of the motor and the wind; the only movements necessary an occasional slight pressure on the joy-stick to one side or the other to keep the proper direction. I came very nearly going to sleep, it was so peaceful up there; several times closed my eyes and swayed a bit.

As a matter of fact, one is perfectly safe at that altitude—anything over a thousand feet—because the machine, at least this particular type, won't get into any position from which one cannot get it out within 200 meters at most. But nevertheless I haven't tried any impromptu falls as yet.

This morning I repeated the same identical performance, because for some reason we have to do two "petits voyages," and had much the same kind of a time as yesterday. On the way home one cylinder quit its job and threw oil instead, covering me from head to foot and clouding up my goggles so I had to wipe them off about every minute. When I got back the mechanics decided that that motor had died of old age and would have to be repaired, so I am again without a machine.

Have watched a beautiful afternoon pass by from the barracks, when without my luck I'd be working. But with a machine and weather I can be finished tomorrow; two triangles to do, about 200 kilometers (125 miles) each, and I can do one in the morning and the other in the evening and then I'm breveted. Perhaps by day after tomorrow I'll start *perfectionne* on Nieuport. I hope so.

FLYING IN A NIEUPORT

September 9, 1917.

Since my last to father, I have had some very interesting times. First, I finished my brevet with very little excitement, made all my voyages, and only got lost a little bit once. Then I saw two machines on the ground in a field, made a rather dramatic spiral and steeply banked descent midst a crowd of villagers, and got away with it; then found that the machines belonged to two monitors who were bringing them from Paris and had effected a *panne de chateau.*

Being demanded what I was doing, I fortunately found a spark plug on the burn and got that repaired, and "alley oop!" The rest of it was very easy—a bit of flying in the rain which stings the face a bit, but is not bad otherwise.

Since I have been on the Nieuport. There are three sizes of machines on which one is trained, starting with the larger double-command and going to the smallest. At Pau we got another even smaller, about as big as a half a minute. Four times I went out without a ride—bad weather, crowded class, and hurted machines; the same old story.

Then last night I had my first rides with a monitor who is rather oldish, crabbed, and new at his job—a brand-new aviator. As you know, when an airplane takes a turn, it does not remain horizontal, but banks up—*comme ca* (if you can interpret that illustration; it shows signs of remarkable imaginative power). *Alors,* one banks to ———— (trees), takes a turn, and uses the rudder only a very little because the machine turns along when banked. There is a sort of falling-out feeling the first few times, until one becomes a part of the machine.

To get back to the story: This monitor does not like to bank his machine, and sort of sidles round the corners, keeping it quite flat and almost slipping out to the outside of the turn. I have done many fool things in a machine and made many mistakes, but never have I been so scared in anything in my life as when riding with this monitor. A monitor is supposed to let the pupil drive as much as he is able, but this bird never let me make a move, and when we got through told me I was too brutal.

I was never madder in my life and cursed nice American cuss words all the way home. There's a 15-kilo ride in a seatless tractor back to camp to improve a bad humor.

"THE MADDEST MAN I EVER SAW"

Well, this morning I saw some more rides impending and didn't like it, so

asked the *chef de piste* to put me with another monitor. He had to know why, and I registered my kick, which practically said that the first monitor didn't know his business and couldn't drive; that I was scared to ride with him. The *chef* was a bit sarcastic, and told me to take two rides with another monitor to show how *I* could make a *virage*. I did it the way I've been accustomed to; made a fairly short turn. When we got down, the monitor said, "Eclatante" (Am. "stunning"), or something like that, to the *chef*.

The *chef* had meanwhile communicated my complaint to the first monitor, and he was the maddest man I ever saw. Demanded what *"ce type la,"* indicating me, wanted; said the *virages* I had just made were dangerously banked (the monitor I was with didn't mind, though), and then all three started arguing at once at me and I spelled all the French I knew.

Then, of all things, the lieutenant, without further remarks, said I was to continue with my first monitor. My heart sank into my boots. I had visions of staying in that class without rides, or with only rides and fights, for months. I rode no more this morning, and what was my delight to find this evening that my bewhiskered pal had left on *permission*.

I got another monitor, a fine one, who put his hands on the side of the machine and let me do everything, with a bit of assistance on the landing, which is different from what I've been doing on the Caudron. Seven rides and a finish—the 23-meter tomorrow morning. I wasn't very good, but got by.

September 14, 1917.

Things for me are going all right. Have made progress on the Nieuport since last I wrote and will fly alone soon. As regards the U. S. Army, things are at a standstill until I get to Paris, which will be a week or so. I hope to go to the front in a French Escadrille and in an American uniform. Some say it can be done; some that it cannot. It sounds so sensible that I am afraid there must be some regulation against it.

THE TRUCK SALVAGES THE WRECK WHEN A PUPIL "CAPOTES"

September 27, 1917.

Since last I wrote a regular letter, considerable has taken place. First, I am now at Pau, having finished up Avord. Have sent post-cards to father right along to keep track of movements. After brevet was over, I did not take the customary permission of 48 hours, but went straight to work on Nieuport D. C. (double command). One cannot learn a great deal riding with an instructor—only about enough to keep from smashing in landing, because one never knows when the instructor is messing with the controls, when it's one's self.

There are five kinds of Nieuports—differing mainly in size, the smaller being faster and more agile in the air, better adapted to eccentric flying. They are 28, 23, 18, 15, 13 (the Baby Nieuport). At Avord I had about a week of D. C. on 28 and 23 (the numbers refer to size of wings), with several days of no work. Then some days on 23 alone, and finally on 18 alone.

The landings are a bit different from those of the machines I had been flying, as they are faster, and the machines are quite nose-heavy. In the air the nose-heavy feature makes them "fly themselves"—that is, according to the speed of the motor the machine will rise and climb or *piqué* and descend, with never a touch from the pilot. If the weather is not very bad, the Nieuport will correct itself automatically from all displacements.

But in landing the nose-heavy feature causes a great many *capotages*. If the landing isn't done about right with the tail low, over she goes on her nose or all the way onto her back. It is a very common occurrence and has become almost a joke. When a pupil "capotes," everybody kids him. No one hurries over to see if he is hurt; not at all He climbs out from under, usually cursing, and in ten minutes the truck is out to salvage the wreck.

It is astounding the way smashes are taken as a matter of course. Yesterday one chap in landing hit another machine,

Photograph by Edwin Levick

A TRIO OF PLANES AT A TRAINING CAMP FOR AVIATORS

In the "air colleges," which the government has established recently, the time between matriculation and graduation is measured in months instead of years, but if the period of education is shorter in these schools than in regular colleges the expense is in inverse ratio. A conservative estimate of the cost of training an aviator is from $10,000 to $20,000. Great tracts of land are required for ground schools; many airplanes must be kept on hand, as the breakage is heavy, and repairs are often tedious; motor trucks and motorcycles are necessary subsidiary equipment.

demolishing both, but not touching either pilots, being worth some $15,000 or $25,000, but no one seemed to worry—it's very much a matter of course. The monitor was a little peeved because he will be short of machines for a few days, but that was all. I've seen as many as ten machines flat on their backs, or with tails high in the air, on one field at the same time.

For myself, I haven't capoted or busted any wood since the Bleriot days, but I'm knocking on the wooden table now. On several occasions it has been only luck that saved me, as I've made many rotten landings.

Well, to get back to the diary. After finishing at Avord, I waited around for two days to get papers fixed up, requested and obtained a *permission,* and

then decided not to use it and left straight for Pau, after fond farewells to the friends I've been with for 3½ months. Looking back, I didn't have such a bad time at Avord after all, though I did get terribly tired of the living conditions.

DIFFICULTIES OF TRAVELING IN FRANCE IN WAR TIME

My trip to Pau I put down to experience. I discovered one schedule not to travel by in future. Leaving Avord at 2.15, I got to Bourges at 2.45 and found that the train left at 7.29. Fortunately, there was another chap from the school on the train, Arthur Blumenthal, an old Princeton football star, whom I have gotten to know quite well, so we managed to waste the afternoon together; almost made ourselves sick on candy and then ate ourselves stupid at the hotel at dinner time.

At 7.29 I started another half-hour's journey, at the end of which the timetable said that the train for Bordeaux left at 10.30 (this is all p. m.). At this town there were some American engineers, so I embraced the fellow-countrymen in a strange land. Finished up a not very gay evening by attending the movies—a most odd institution. Clouds of tobacco smoke obscured the screen, and most of the action was around the bar at one side of the hall. Nobody was drunk, but nearly every one was drinking and very gay. This was merely Saturday night in a small town of the provinces; not in gay Paree.

At 10.15 I got in a first-class compartment and tried to find a comfortable position in which to sleep. At 2.15 a. m. I had mussed up my clothes considerably, lost my temper and not slept a wink. Then we had to change again. The rest of the morning I sat opposite an American officer, a queer old fogey, and we tried to kid each other into thinking we were sleeping, with no success. Arrived at Bordeaux at 7 a. m. and found that the train for Pau left immediately, so I missed out on breakfast, too—oh, it was a hectic trip. My idea of a very unpleasant occupation is that of a traveling salesman in France.

QUARTERED WITH HEROES OF THE LAFAYETTE ESCADRILLE

Escadrille Spa-84,
Secteur Postal 181,
Par A. C. M.—Paris.
November 1, 1917.

Well, I'm here—in sight of the front at last. To date I haven't been out there yet and won't for a few days more, as they take lots of care of new pilots and don't feed them to the Boche right away. Probably day after tomorrow the lieutenant in command will take me out to show me around the lines, and after that I'll take my place in patrols with the others.

The work is exclusively patrolling, establishing, as it were, a barrage against German machines and preventing as far as possible any incursions of the French lines. As the big attack is over, there is comparatively little activity. Sometimes one goes for a whole patrol without being fired on and without seeing an enemy machine anywhere near the lines.

During the three days I've been here the group has accounted for several Boches without any losses whatever. Young Bridgeman, of the Lafayette Escadrille, had a bullet through his fuselage just in front of his chest, but suffered no damage except from fright.

There are several escadrilles in the group—a *Groupe de Combat* it is called; all have Spads, which makes it very nice. The Lafayette, 124, is of our group and have adjoining barracks, which makes it very nice (I seem to repeat) for us lone Americans in French Escadrille. We drop in there far too often and the first few nights I used the bed of the famous Bill Thaw's room-mate, away on *permission.*

Did I write you that one morning he brought in Whiskey to wake me up, and my eyes no sooner opened than my head was buried under the covers. Whiskey is a pet—a very large lion cub—which has unfortunately outgrown its utility as a pet and was sent yesterday, with its running mate, Soda, to the zoo, at Paris, to be a regular lion.

They are a very odd crowd—the members of the Lafayette Escadrille—a few nice ones and a bunch of rather rough-

© Brown & Dawson

THE TYPE OF TAUBE WHICH MADE THE FIRST AIR RAIDS ON PARIS

This plane, whose outspread tail and rounded wings so closely resemble those of a bird, is too slow to contend with the 1918 type of 125-miles-an-hour machine which is now a commonplace of the Western Front. It is to the latest speedster warplane what the "one-lunger" automobile of fifteen years ago is to the 12-cylinder racer of today. This style airplane still has its uses in the aviation schools, however.

necks. Their conversation is an eye-opener for a new arrival. Mostly about Paris, permissions, and the *rue de Braye,* but occasionally about work and that *is* interesting. Nonchalant doesn't express it. When Bridgy got shot up, as mentioned above, they all kidded the life out of him, and when he got the Croix de Guerre, they had him almost in tears—just because he's the kiddable kind.

But in talking about the work, for instance, Jim Hall: "I piqued on him with full motor and got so darn close to him that when I wanted to open fire I was so scared of running into him that I had to yank out of the way and so never fired a single shot."

Or Lufberry just mentions in passing that he got another Boche this morning, but those —— observer people won't give him credit for it. He has 14 official now and probably twice as many more never allowed him. Some days ago during the attack he had 7 fights in one day, brought down 6 of them and got credit for one; which must be discouraging.

© Kadel & Herbert

A SHAM BATTLE IN THE SKY

One of the final tests given a student aviator before he is commissioned as an experienced pilot is a sham battle, in which the newly trained fighting man is given an opportunity to display his ability to outmaneuver his opponent and get in position for the "assassination," as the French say.

SEASICK IN THE AIR

November 10, 1917, Evening.

You know November in France. I've been here almost two weeks now and am still à l'entrainment; that is, I haven't started in to do any regular work yet. Only five times have I been able to fly in two weeks. But I've got my own machine and mechanic, everything is in order, and I've been assigned to a patrol the last two mornings when it rained.

Tomorrow again at 8.50 with four others—patrol for one hour and fifty minutes at about 15,000 feet, back and forth over our sector, sometimes over our own lines, sometimes in Bochie. I'm getting very impatient to get started. In what few flights I've had, I've been working on acrobacy a bit and am gradually learning a few simple things; twice I stayed up a little too long and had to lie down a few hours afterward, almost seasick.

I like Spa 84 very much indeed. The Frenchmen there are regular fellahs.

Wertheimer, a sergeant, is a sort of informal and unadmitted chief of the *sous-officiers*. It is he that speaks English and has helped us a lot in getting settled, etc. Very much of a gentleman he is and understands a bit of Anglo-Saxon customs and eccentricities, always gay and an indefatigable worker.

We have all been arranging the one big room of our barracks—dining room, reading-room, and probably eventually American bar. The walls are covered with green cloth, green paper (of two different shades and neither quite the same as the cloth), red cloth (on top as a sort of frieze), and red paper. The ceiling is done in white cloth to keep in heat and lighten the room. A monumental task it has been, especially as materials are hard to get and expensive.

FED AMAZINGLY FOR FOUR FRANCS A DAY

Wertem (as Wertheimer is called) and Deborte have done most of the work. Deborte is also *chef de popote,* which means housekeeper, and a very efficient man. For four francs per day we are fed amazingly well, especially when one realizes that we are near the front in a country which has had three years of war. Deborte hasn't the pleasantest manner in the world at times, but usually is very agreeable, willing to tell me things about flying or the escadrille, always ready to work, and a dependable man in the air.

And Verber, who rooms with Wertem, he speaks a little English; has a great deal of trouble understanding it, but is picking up; wears a monocle all the time, because he's got a bum eye; carries a stick, and has an extremely eccentric appearance, but withal is very agreeable and a very valuable man. He has the habit of taking long trips all alone, far into Germany, just to see what is going on.

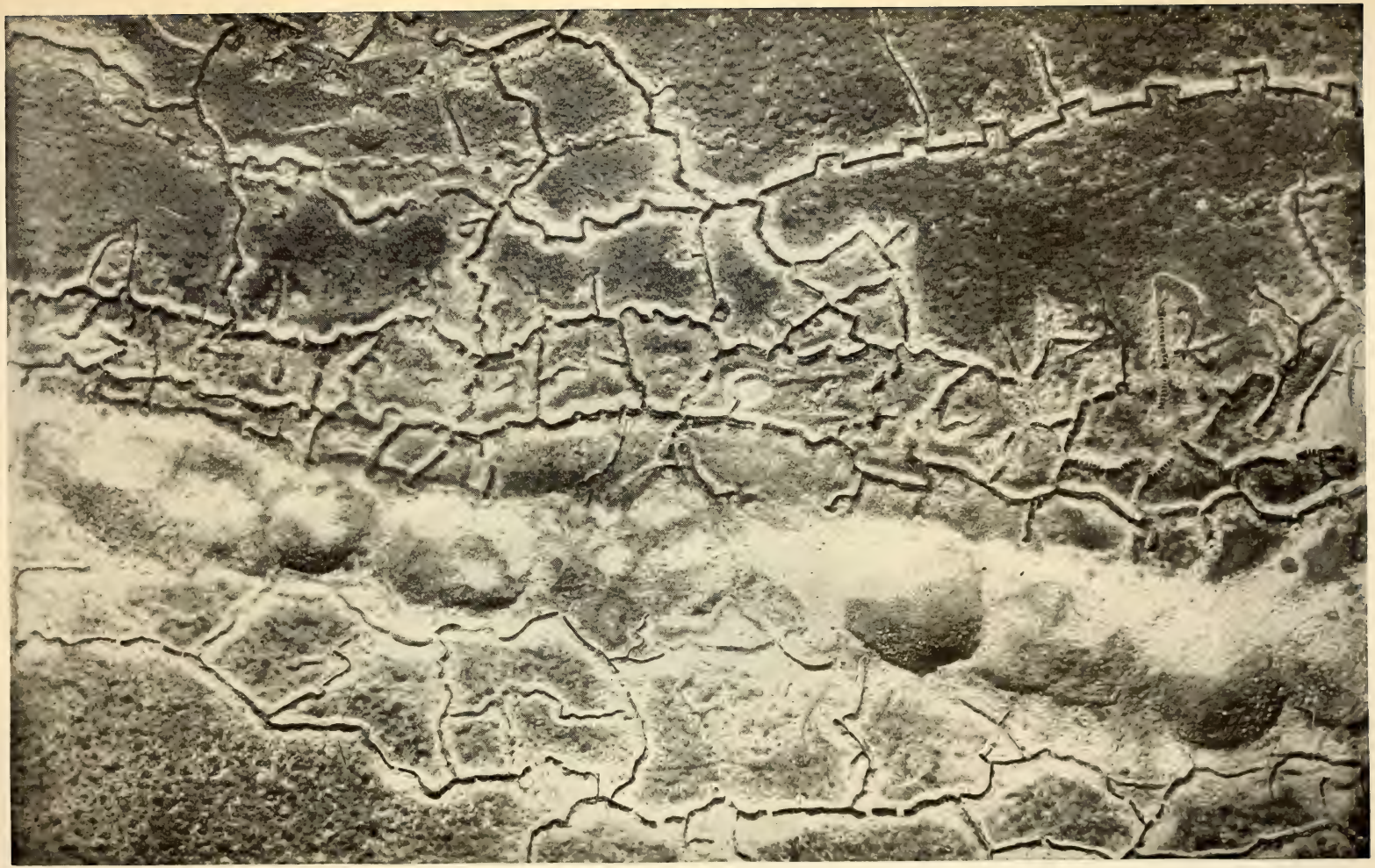
Pinot is the name of the little roly-poly chap everybody calls Bul-Bul, who used to be a mechanic and now is a very good, merry pilot. He has a great penchant towards Pinard, is violently but not at all objectionably non-aristocratic, is forever laughing or kidding some one, walks on his hands to amuse people, and is the delight of all the mecanos.

Demeuldre is a very quiet sort of school-boy type, who has been a pilot of biplanes and reconnaissance machines for a long time. He came to the escadrille recently with a record of two Boches as pilot of a biplane (that is, his machine-gun man did the shooting and they both get credit), and a few days ago brought down a German in flames, his first as *pilot de chasse.* There are two others away on permission, whom I don't know yet.

ESCAPING DESTRUCTION BY A MIRACLE

Somewhere in France, November 13, 1917.

DEAR FATHER: Campbell was in the Lafayette Escadrille and they are a member of the same group as Spa 84, so I have asked them about him. He was on a patrol with another chap; they attacked some Boches and when it was over the other chap was alone. Campbell was brought down in German territory and so reported missing. I believe that the chap he was with has seen and talked to Campbell's father or some close relative since.



A VIEW OF THE GERMAN FIRST AND SECOND LINE TRENCHES ON THE WESTERN FRONT: FROM A PHOTOGRAPH TAKEN AT AN ELEVATION OF 3,300 FEET

The most conspicuous features of this warscape--the five deep depressions in the lower half of the photograph—are not shell craters; they are the scars left by the explosion of mines under enemy listening posts which had been dug out into No Man's Land. In studying aërial photographs it is usually easy to distinguish between the German and French lines from the fact that the German system almost invariably consists of two well-defined lines of trenches, while the French have one, a first line with numerous irregular ramifications.

Another chap named Bulkely was brought down in similar circumstances about the first of September. Ten days ago, word was received from the American Embassy that he had communicated with them, a prisoner in Germany. There are many similar cases, where men brought down with crippled machines or wounded, escape destruction by a miracle. The only sure thing is when a machine goes down in flames or is seen to lose a wing or two.

For instance, there are two officers in the group who are in the best of health and daily working. Several months ago they were on patrol together; collided in the air. One cut the tail rigging completely off the other and they separated, one without a tail and the other with various parts of a tail mixed among the cables and struts of one side of his machine. They both landed in France, one on his wheels, followed by a *capotage,* or somersault turnover, the other quite completely upside down. Then a term in the hospital and back they are again.

THRILLING FEATS OF DARING

Kenneth Marr, an American, had the commands of both his tail controls cut in a combat, the rudder and elevator, leaving him nothing but the aileron—the lateral balance control and the motor. He landed with only a skinned nose for casualties and got a decoration for it.

Another chap in an attack on captive balloons, drachens, dove for something like 10,000 feet *vertically* and with *full motor on,* thereby gaining considerable speed, as you can imagine. He came right on top of the balloon, shot, and to keep from hitting it, yanked as roughly as he could, flattening out his dive in the merest fraction of a second.

Imagine the strain on the machine! When he got home all the wires had several inches sag in them; the metal connections of the cables into the struts and wood of the wings had bit into the wood enough to give the sag.

Machines are built to stand immense pressure on the under side of the wings. In some acrobatic maneuvers I was trying the other day, I made mistakes and caused the machine to stall and then fall in such a way that the full weight was supported by the *upper surface*—by the wires, which in most machines are supposed merely to support the weight of the wings when the machine is on the ground.

Yes, the Spad is a well-built machine—the nearest thing to perfection in point of strength, speed, and climbing power I've seen yet. Of course, it's heavy, and that's why they put 150 to 230 horsepower in them. The other school, that of a light machine with a light motor, depending for its success on lack of weight rather than excess of power, may supplant the heavier machine in time; I can't tell.

WHEN DECORATIONS ARE BESTOWED

So, as any one who knows has said right along, there is a long way to go in the development of the J. N., or even the little triplane, before American-built planes get to the front. Of the bombing game I don't know anything at all.

Yesterday there was a revue here in honor of Guynemer and decorations for the pilots of the group who had won them. Three Americans received the Croix de Guerre—members of the Lafayette Escadrille. Lufbery, the American ace, carried the American flag presented to the escadrille by Mrs. McAdoo and the employees of the Treasury Department, beside the two aviation emblems of France.

He was called to receive his decoration "for having in the course of one day held seven combats; descended one German plane in flames and forced five others to land behind their lines" (which means that he is officially credited with one, his thirteenth, and that the other five, though probably brought down, do not count for him because there were not the necessary witnesses required by the French regulation).

Being the bearer of the flag, he was a very worried man to know what to do with the flag when he should go up to get his medal, till one of the fellows in 124 (the Lafayette) came to his rescue. For a military revue it was decidedly amusing. Aviators are not very military.

The chief of one of the escadrille was

commissioned to command the mechanics who are plain soldiers, with rifles and steel helmets for the occasion. He is a bit of a clown and amused the entire gathering, kidding with the officers. The pilots of each of the five escadrilles were in more or less formation; most of them with hands in their pockets, for it was chilly, and presenting a mixture of uniforms unparalleled in its heterogeneity; every branch of the service represented and endless personal ideas in dress.

Because of the occasion, *repos* has been granted to the entire group for the afternoon, another group taking over our patrols; so that after the revue every one had the afternoon to waste—a sunny day, which is quite unusual this month. Within a half hour every machine that was in working order was in the air, forming into groups and then off for the lines, just looking for trouble—voluntary patrol they call it—which opened my eyes a bit to the spirit in the French aviation service after three years of war.

Word from Paris that those Americans in the French service who have demanded their release to join the U. S. A. have obtained that release, which probably means that all we wait for now . . . on the commissions.

This afternoon I took another trip with one of the old pilots to look over the sector. We stayed over France and didn't get into trouble, although there were lots of Boches around. Hope to get really started soon.

An amusing one this morning: Two pilots from the group were on patrol and attacked a single German about two kilometers behind the German lines. They completely outmaneuvered him; he got cold feet and started for the French lines, giving himself up. The funniest part about it is that the machine gun of one of the attackers was jammed and he couldn't possibly have hurt the Boche—just had the nerve to stay and throw a bluff.

They came back to camp just before dark this evening, one of them flying the German machine and the other guarding him in a Spad. The machine is an Albatross monoplane (biplane), finished in silver, with big black crosses on the wings and tail—a really beautiful thing. It flew around camp for several minutes before landing. It is the second machine that has been scared down since I've been out here.

A MIMIC COMBAT IN THE AIR

At the Front,
Somewhere in France,
November 17, 1917.

At present things are hopelessly slow on account of bad weather, so I have a good deal of time to write and naught to write of. I still am waiting for my baptism of active service, which is assigned for each day and held up on account of fog, low clouds, or rain. In the afternoon it usually lifts a little, not enough to fly over the lines, but sufficient to permit a little *vol d'entrainment*—a practice flight around the field. I've been taking every chance to learn to fly—practicing reversements, vertically banked turns, 90-degree nose dives, etc.

Two days ago we had a very interesting mimic combat in the air. The Boche machine, which has been captured, and a Spad, both driven by very clever pilots, maneuvered for position during 15 or 20 minutes at 1,000 feet or less, back and forth over the field, doing almost every possible thing in the air—changing direction with incredible rapidity, diving, climbing, wing-slipping, upside-down dives—everything under the sun.

Two of them were at it again today in two Spads—just maneuvering. What a lot there is to learn! When I got through acrobacy at Pau, I had the impression that that kind of stuff was relatively easy; now I know different. For the present I'm working on the system of try one thing at a time; get that fairly well and then commence another. And small doses—10 or 15 minutes for an acrobatic flight; not more—because one can easily get dangerously sick in a very short time. Not that there is any particular peril in getting ill in the air; only it's beastly uncomfortable.

RATHER GET A BOCHE THAN A COMMISSION

At the Front,
Somewhere in France,
November 30, 1917.

The rumor at the Lafayette Escadrille

B. STUART WALCOTT, THE AMERICAN AVIATOR

this evening is that they have been at last transferred. Of course, they had similar rumors many times before. For myself I am becoming rather indifferent; very well satisfied here, except for weather, and getting what I came over here for.

Father mentioned something about a monitor's job (after I had had experience at the front). My present inclination is decidedly against the idea. There is no job in the world I like less to think of, and there are plenty of people who want to get comfortably settled in the rear; so let them, say I, and may they enjoy it. It is not a very pleasant job.

As a retirement after a period of service at the front, it is another matter. Of all people I can think of I have the smallest right to an *ambussé* job at present; so here I hope to stay. Whether I fly with an American or French uniform, I don't care very much at the present moment. I had rather get a Boche than any commission in the army; but one cannot always tell about the future; perhaps after a few good scares I'll be ready to jump at a monitor's job.

THE STRENGTH OF A SPAD

At the Front,
December 1, 1917.

I tried to give you all some idea of the strength of a Spad in a letter a while ago. At home people speak of a factor of safety, meaning the number of times

stronger the machine is than is necessary for plain flying. The Spad is made so that a man can't burst it, no matter what he does in the air—dive as far and as fast as he can and stop as brutally as he can, it stands the racket. Of course, motors do stop, and if it happens over a mountain range—well, that's just hard luck.

Have had a few patrols since last I wrote; one at a big height, 4,000 to 4,500 meters, considerably above the clouds, which almost shut out the ground below, a wonderfully beautiful sight, but beastly cold, and a couple when the clouds were low and solid. The patrol stays at just the height of the clouds, hiding in them and slipping out again to look around.

If it stays below, the enemy anti-aircraft guns pepper it, whenever near the lines and at a low altitude, that is rather awkward; so the patrol shows itself as little as possible.

It's lots of sport to try to keep with the patrol; be behind the chief of patrol, see him disappear and then bump into a fog bank, a low-hanging cloud, and not see a darn thing; then dive down out of the cloud, wondering whether the other guy is right underneath or not; shoot out of the cloud and see him, maybe 500 yards away, going at right angles; then bank up and turn around fast and give her the gear full speed to catch up, and so on; see a Boche regulating artillery fire, start to maneuver into range, and zip! he's out of sight in the clouds, and the next you see he is beating it far back of his lines. Not very dangerous this weather, but lots of fun.

Châlons sur Marne,
December 8, 1917.

Yesterday we were awakened at 6 and told that we were going to move out, bag and baggage, at 2. So, as new barracks were not ready, we came down here last night and have been seeing the sights of the town since. It is full of Americans, ambulances, doctors, Y. M. C. A. workers, everything but fighting men, which I trust we'll see before long.

THE LAST FLIGHT

On December 12, while on patrol, B. Stuart Walcott met a German biplane carrying two men. Three cable reports agree that he shot down and destroyed this machine about two and a half miles within the German lines. He then started back for the French lines and was overtaken by three Albatross German planes. He was overcome and his machine went down in a nose dive within the German lines, it being assumed that either he was shot or his machine disabled.

There was still a hope that he might have escaped death. Inquiries were at once instituted through the American Red Cross and the International Red Cross, with the result that on January 7 a cable came from the International Red Cross stating that it was reported in Germany that S. Walcott was brought down during the afternoon of December 12 near Saint Souplet, and that he was killed by the fall.

On January 11 the French Government awarded the Croix de Guerre to the fallen flyer, with the accompanying citation:

"Corporal Walcott, an American, who volunteered for the duration of the war, and a young pilot of admirable spirit and courage, on December 12, 1917, attacked an enemy airplane. He pursued it four kilometers behind the German lines, where he brought it down. He was in turn attacked by three other monoplanes and was driven down."

The medal was received on his behalf by members of his squadron and has been forwarded to his father, Dr. Charles D. Walcott, Secretary of the Smithsonian Institution, Washington.

THE FUTURE OF THE AIRPLANE

By Rear Admiral Robert E. Peary, U. S. Navy

UTILIZATION of the atmosphere for commerce and transportation presents possibilities far beyond anything that we can now imagine.

Sea power—military and commercial—has been for centuries an absolute essential to every great nation, insuring its continued existence and opportunities for legitimate growth and expansion.

We are now entering upon an era of air power—a stupendous era—which in the near future will be as far superior to the greatest sea power of the present as the unlimited ocean of atmosphere now sweeping unbroken around the globe is greater than the land-bordered Atlantic or Pacific.

The beginning of this era, the opening up of a mighty and entirely new world for exploitation, presents to the United States, with its unique geographical position, its boundless resources, mechanical and inventive ability, and its splendid reservoir of ideal American manhood, the opportunity to be the *first air power in the world.* This should be the second article in our national creed, the first article in that creed being the Monroe Doctrine.

In the midst of our great plans for carrying the war home to Germany through the air we must not forget to protect our own valuable and vulnerable coasts and coastwise shipping with airplanes.

The eagle is our national emblem. Give us 10,000 fighting sea-eagles—far-seeing, swift-flying, steel-taloned—to render our coasts immune from the bloody "killers" of the sea.

Give us thousands of swift sea-going hydro-airplanes, with capacity for carrying powerful guns and bombs; perfect a device—bomb, torpedo, or gun—that will enable a plane three times out of five to destroy a submarine on or just below the surface; then drill, and *drill,* and DRILL with this device until our airmen have the deadly precision of the dead shot with his gun, the whaleman with his harpoon, and the cowboy with his lasso or revolver.

Any one who has seen a fish-hawk or a sea-eagle sweep over the surface of the waves, then pause, hover for a moment, dive like an arrow, and proceed with a fish in its claws will understand the statement that when we have ten powerfully armed airplanes to assign to every lurking, murderous submarine, the finish of the undersea craft will be as inevitable as that of the fish.

This method of defense can be made so effective by American skill and energy as to constitute a complete protection for our coasts, leaving our swift battle cruisers and destroyers free for a far-flung offensive in any one of the seven seas.

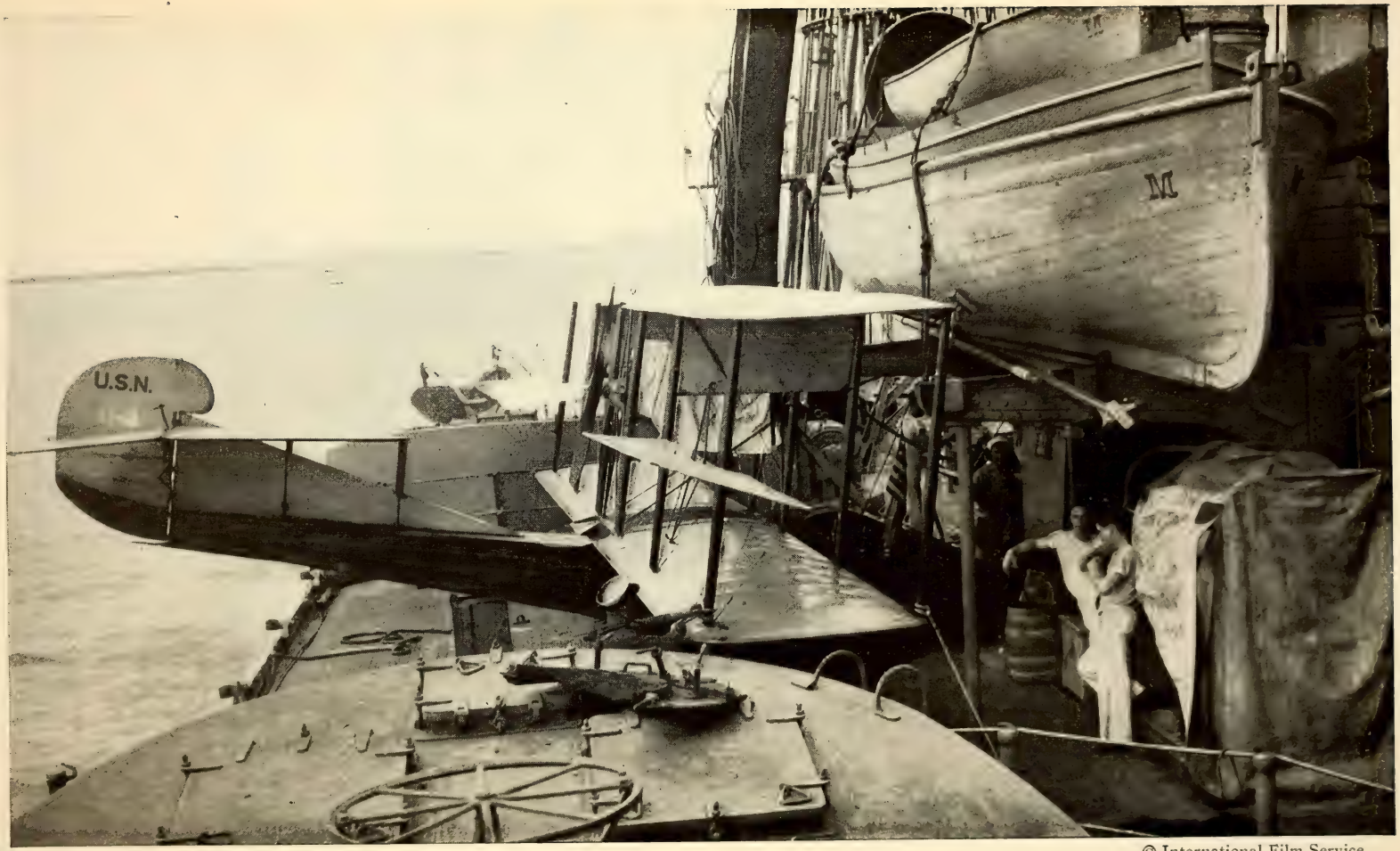
Not only must America depend upon her air fleets to protect her from the attack of hostile sea fleets, but from air raids upon her cities, for the rapid advancement in the science of aviation makes it only a question of time before we shall be vulnerable to attack from above, even though the enemy be separated from us by thousands of miles of ocean.

AIR ADMIRALS OF THE FUTURE

The military evolution of the airplane has advanced from the single machines, scouting and fighting hand to hand, to the squadron of twelve planes; then to bombing companies of thirty to forty machines; then to the formation, as in the battle of Messines Ridge, last June, where three strata of Allied aircraft were engaged—the fighters in the upper, the observers and bombers in the middle, and the machine-gun planes in the lower, close to the ground. This work of the air service really won the battle.

We are now very near the stage that I ventured to suggest two years ago, in which the aërial unit will be 500 to 1,000 machines, and we shall have air divisions made up of brigades, each composed of several such units.

The air admiral of the near future will need to know more than the possibilities of an aëro squadron. He must know from long practice, drills, evolutions, and



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A NAVAL HYDRO-AIRPLANE LASHED TO THE DECKS OF A BATTLESHIP FOR TRANSPORTATION

"The air has a call of its own that few can resist. It runs through a man's veins like flame and whispers courage and defiance into his ear. It invites his sympathy, love, and esteem. Every known sensation is experienced in flying: joy—the joy of youth astride the dull old world, accomplishing what previous generations dared not attempt; excitement—a feeling that comes from the cool air flying past one's face and whistling by one's ears; also fear, danger, hope, despair, and elation—all these are crowded into one brief hour of life."

experience the possibilities and the methods of handling an aëro division made up of brigades of aëro squadrons.

SUBMARINE SECONDARY TO AIRPLANE

The submarine, an American invention perfected abroad, ranks at present with the airplane as a revolutionary device, but in my opinion it will soon take second place.

The fundamental limitations of the airplane are less than those of the submarine. It possesses potentialities of offensive in the air, on the sea surface, and under the sea. In other words, airplanes can attack other planes or dirigibles, they can attack ships, and they can attack submarines.

The possibilities of the submarine can and probably soon will be confined to under-surface offensive. The range of the airplane is much greater than that of the submarine. To the flying machine sea or land is all the same. It can go wherever there is air. In the case of nearly all European nations, except Great Britain, the land phase of flying will probably be the most important. With us the reverse is the case and our geographical position and thousands of miles of coasts make the marine phase most important to us.

It must be fully recognized, as a matter of permanent national policy, that the air fleets of the United States must be both numerous and powerful enough to patrol and protect all sea approaches to the entire continent of North America.

AMERICA RICH IN AVIATOR MAN-AND-WOMAN POWER

As regards aviation personnel, the United States is uniquely favored. In numerical strength we surpass every other nation except Russia and China. The Lafayette Escadrille in France has already given the world a practical illustration of the kind of aviators Americans make.

Along our thousands of miles of coasts there is a quantity and quality of personnel that is among the most valuable assets of this country. It is the personnel composed of the young boatmen, fishermen, sailors, and those who have been brought up beside and earned their living on and by the ocean. They constitute the nucleus of a personnel which is hardy, courageous, enduring; knows the sea and its ways; has the sense of navigation born in it, and above and beyond all has the quality of individual initiative and the power of instant execution developed to the highest degree.

Take the young fellow who, from the age of six or eight, has been handling his own boat, and from the age of 12 or 14 has, singlehanded, driven his fishing boat daily offshore almost out of sight of land, made his day's haul, and has driven his craft back home again in the teeth of all kinds of weather. I know this breed well. I have cruised with them many an hour. I can feel the salt spray of 45 years ago upon my face and in my eyes now. I know their capabilities—rosy-cheeked, clear-eyed, fearless, alert, and quick as a cat.

These youngsters can take their motors apart and put them together again with eyes shut, and they can keep them going under all circumstances, in a way that at times seems almost unbelievable.

They have been forced to this by the supreme incentive of safety for one's own life. When fighting the breaking seas of an easterly gale off the Maine coast, if motor trouble develops the cause of it must be determined at once and the remedy applied instantly. If not, the little boat broaches to, a sea comes roaring aboard, and the life story of that particular youngster comes to a full period.

In considering the air personnel resources of America, the patriotism, intrepidity of spirit, and energy of the young women who are anxious to fly must not be overlooked. That women can become skilful aviatrices has been splendidly demonstrated by the brilliant achievements of Miss Ruth Law and Miss Katherine Stinson.

WAR'S BIRDMEN TO PLAY USEFUL RÔLE IN PEACE TIMES

That the young men who are training for fliers in war service will have an important and useful rôle to play in the commercial, industrial, and scientific growth of aviation is apparent.

When peace comes thousands of men and thousands of planes will be required for the mail service of the future, for policing the air, for aërial coast patrol,

for aërial map-making by means of aërial photography, for exploration, and for rapid transit of passengers and freight.

An aërial mail service has already been outlined tentatively in Europe by both the Entente Allies and the enemy governments. France and England have had committees at work for nearly 12 months on plans for utilizing their air fleets and air personnel after the war; Bavaria has proposed an aërial traffic service for central Europe, and Prussia is said to be perfecting arrangements for a peace-time Hamburg-to-Constantinople mail and passenger service.

How extensive may prove this after-the-war aviation service may be surmised from the fact that already airplanes have been perfected which are capable of carrying aloft 25 passengers; other machines have developed a speed of 150 miles an hour, while the record non-stop flight to date is 1,004 miles, only 191 miles short of the longest water gap in the America-to-Europe air course, by way of the Azores from Newfoundland. That transatlantic flight is a certainty of the next few months, no reasonable person doubts.

British authorities have expressed the belief that it will soon be possible to go from London to Paris and return in one day, or from London to Bagdad in a day and a half; to New York in two days, and to Ceylon in two and three-quarter days. Air routes to India, with air currents and possible landing stages are even now being mapped.

Every obstacle of nature has been overcome by the airman—deserts, seas, and mountains. The attainment of an altitude of four miles is now almost commonplace, and the Alps have been conquered on numerous occasions.

AIDING THE GOVERNMENT IN TRAINING FLYERS

That America is not waiting supinely for peace to be declared before she makes her preliminary preparations and experiments for the age of the airplane is indicated in the establishment recently of a well-marked air route from Dayton, Ohio, to Rantoul, Ill., as an aid to the training of aviators.

This work has been carried forward under the direction of Carl G. Fisher, of Indianapolis, chairman of the Mapping Committee appointed by the National Advisory Committee on Aëronautics.

The initial program for a marked route consisted of serial numbers painted in large white figures on barn roofs, with an arrow pointing the direction where a clear field of the proper area for safe landing might be found, in the event an emergency landing was necessary.

With the Indianapolis Motor Speedway as a central point, landing field numbers from 1 to 72 were painted on barn roofs between the speedway and Dayton, at an average distance of about two miles apart. From the speedway to Rantoul the field numbers ranged from 1 to 28; size used, 6 to 10 feet long by 24 to 36 inches wide. The distance between the fields on this end of the route averaged about four miles.

This campaign required the services of two men and a specially equipped motor truck and consumed two and one-half months' time. To complete the numbering, 111 gallons of paint and 50 gallons of oil were used.

Following the landing field or daylight route marking scheme, the second phase of the work was to afford assistance in furthering the difficult training in night flying. A patriotic spirit and the desire to assist the government prompted the citizens, town authorities, and civic organizations of the various municipalities selected for signal stations to purchase, erect, and provide for the maintenance of signal lighting equipment at Dayton and Eaton, Ohio, and at Fairfield and Wright flying fields near Dayton; Richmond, Cambridge City, Knightstown, Greenfield, Cumberland, Fort Harrison, Indianapolis, Indianapolis Motor Speedway landing field, Brownsburg, Jamestown, Crawfordsville, Waynetown, Veedersburg, and Covington, Indiana; Danville and Champaign, Illinois, the last-named city being only ten miles south of the government training field at Rantoul, Illinois.

Signal equipment consists of four- or six-light projectors with red or green lenses, equipped with lamps of 200-watt capacity. The projectors are mounted on an angle-iron frame four feet square, standing three feet high. Each unit has an automatic flasher system attached. On the four-light frames the projectors

THE FIRST WOMAN TO FLY FROM CHICAGO TO NEW YORK

Miss Ruth Law established a new American cross-country flight record when she piloted her airplane from Chicago to New York, a distance of 832 miles, her actual flying time being nine hours and one minute. Her longest continuous flight lap on the journey was 590 miles. Miss Law is seen receiving the congratulations of Major General Leonard Wood upon her arrival at Governors Island, New York.

AN AVIATOR'S SIGN-POST FOR NIGHT FLYING

"Signal equipment consists of four- or six-light projectors with red or green lenses. They are mounted on angle-iron frames four feet square, standing three feet high. Each unit has an automatic flasher system attached. For indicating the direct flying route from Dayton to Rantoul, lights flash on and off at about six-second intervals."

AN AVIATOR'S LANDING FIELD INDICATED BY HUGE NUMERALS PAINTED ON THE ROOF OF A BARN

The initial program for a well-marked air route from Dayton, Ohio, to Rantoul, Ill., designed as an aid to the training of aviators, includes the painting of large white figures on barn roofs, with arrows pointing in the direction in which the birdmen can find safe landing places.

are set, two lamps directed east and two west. Six-light signals read two east, two west, one north, and one south. East and west lights are trained ten degrees off the direct course. All projectors on both the four- and six-light units are set twelve degrees above the horizontal.

For indicating the direct flying route from the Dayton flying fields to the Rantoul field, lights flash on and off at about six-second intervals. To assist the pilot to check his location, the station at the end of the first fifty miles west of Dayton flashes green and red alternately. The completion of the second fifty-mile leg is indicated by the rapid flashing signal for the Indianapolis Motor Speedway landing field. Continuing west, the third checking signal consists of six green lights flashing on and off, indicating Crawfordsville, Indiana. Again, at Danville, Illinois, the light flashes red and white at six-second intervals. All other units which indicate to the pilot or his observer that they are following the direct course employ red lights flashing on and off at the regular stated intervals.

Drifting with the air currents and unconsciously leaving the direct flying course will be corrected by a system of side marking lights. At about twenty miles north and south of the air route and located approximately twenty miles east to west, two fixed lights are to be stationed. Those on the south will use red and point directly north, while the lamps north carry green lenses and are directed due south; hence, should the airplane drift from the course, the pilot would be reasonably sure to detect either the stationary red or green lights and correct his direction until the flashing signals telegraph the welcome news, "Straight ahead." Lamps used for side markers are of the same type of projectors and are to be purchased, installed, and maintained by the towns where stationed without cost to the government.

On clear nights the radius of all lights will be from eight to ten miles.

FOUR TRANSCONTINENTAL AIRWAYS

The details of this Dayton-Rantoul route present in a general way the nature of the task which the aviation sign-post pioneers will undertake in mapping and marking the four transcontinental airways, proposed by the Aëro Club of America and known as the Woodrow Wilson, the Langley, the Wright Brothers, and the Bell & Chanute routes.

The last of these routes, extending from Boston, Mass., to Seattle, Wash., via Albany, Syracuse, Rochester, Erie. Buffalo, Detroit, Grand Rapids, Minneapolis, Bismarck, and Great Falls, will be a richly deserved memorial to Octave Chanute, the pioneer aëronautic engineer, and Alexander Graham Bell, whose name is more frequently associated with other great gifts to humanity, but who in an unspectacular way was a potent factor in advancing man's mastery of the air.

It was the financial support and personal encouragement of the inventor of the telephone which largely enabled Samuel P. Langley to continue his experiments with heavier-than-air machines—experiments which were of inestimable value to Orville and Wilbur Wright, who finally achieved success.

Alexander Graham Bell's support was given at a time when the foremost physicist of Great Britain, Lord Kelvin (Sir William Thompson), the foremost astronomer of America, Simon Newcomb, and the foremost business genius of this age, Andrew Carnegie, scoffed at the possibility of man's flying.

The name of this airway will also be a tribute to Mrs. Bell, whose gift of $50,000 to the Aërial Experimental Association in 1907-1908 made possible the experiments which resulted in Glenn H. Curtiss and J. A. D. McCurdy taking an active part in the development of aëronautics.

The Woodrow Wilson airway will extend in an airline from New York to San Francisco, with Cleveland, Toledo, Chicago, and Cheyenne the principal cities en route.

It is proposed that both the Langley and the Wright Brothers routes shall have Washington as their starting point. The Langley line will end in Los Angeles, passing near Wright field at Dayton and within a few miles of St. Louis. The Wright Brothers airway will pursue a more devious route through Virginia, North and South Carolina, Georgia, Alabama, Mississippi, Louisiana, Texas, New Mexico, and Arizona, and terminates at San Diego.

GERMANY'S AIR PROGRAM

WHILE America and her Allies have been organizing their wealth, natural resources, and industrial forces to place a fleet of flying machines above the battle lines of Europe this spring, the fact should not be overlooked that Germany and her vassal nations are equally alive to the importance of mastery in the air. Her highly centralized war industries are exerting every effort to match the gigantic program of the Entente Allies.

While no official figures have been allowed to leak from Germany as to just what is being done in preparation for the supreme battle of the sky, the trend of public opinion in the Teuton nations is reflected in such reports as the following news item (translated by a correspondent of London *Flight*) which appeared recently in *Der Motorwagen,* a Berlin journal:

"At a recent meeting of the Deutscher Fliegerbund (German Aërial League) the treasurer, Lieutenant Bothe, of Berlin, gave some interesting details regarding the objects and activities of the League.

"He first gave a very clear and comprehensive survey of the present position of aëronautics in Germany, claiming that the Germans had now really obtained the supremacy of the air on the western front as on other fronts, though he had to acknowledge that at the time of the great Somme offensive the mastery in the air belonged to the British and French.

"This led to a reawakening in German military circles and to a redoubling of their efforts to regain that supremacy, and no stones were left unturned until that object had been successfully attained.

"The Germans had now left their adversaries far behind, both in number and quality of the aircraft being turned out, as the English were learning to their cost.

"Lieutenant Bothe then dealt at some length with the position of military aëronautics after the present war. He foretold that on the cessation of the present hostilities all the nations would at once proceed to build up an impenetrable series of modern defensive works, extending several miles behind their frontiers, and which it would be beyond the power of human beings to break through, except by the aërial arm.

"In future wars it would be necessary to invade the enemy's territories by means of tens of thousands of aëroplanes, which by dropping hundreds of tons of explosives would destroy all industrial works, transport routes, etc., and thus delay the advance of the troops and impede preparations for offense or defense.

"The war would be won within the first few days of the declaration of hostilities by the Power, or Powers, which were thus able to throw in the largest weight of aërial 'frightfulness,' and thereby paralyze the fighting efficiency of their opponents, before even a battle had been fought or a campaign opened.

"Where, it may be asked, are to be found the pilots to man these tens of thousands of aëroplanes? This would be one of the chief duties of the German Aërial League, an institution which was daily growing in importance and influence.

"By suitable courses of training at aërodromes and in the workshops, the youth of the country would be prepared for later service in the Flying Corps.

"The speaker urged every one interested in this subject to give the League all the support possible by joining a local branch and by making its objects more widely known."

INDEX FOR JULY-DECEMBER, 1917, VOLUME READY.

Index for Volume XXXII—July-December, 1917—will be mailed to members upon request.

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THE NATIONAL GEOGRAPHIC MAGAZINE

THE VALLEY OF TEN THOUSAND SMOKES

An Account of the Discovery and Exploration of the Most Wonderful Volcanic Region in the World

BY ROBERT F. GRIGGS

DIRECTOR OF THE NATIONAL GEOGRAPHIC SOCIETY KATMAI EXPEDITIONS OF 1915, 1916, AND 1917

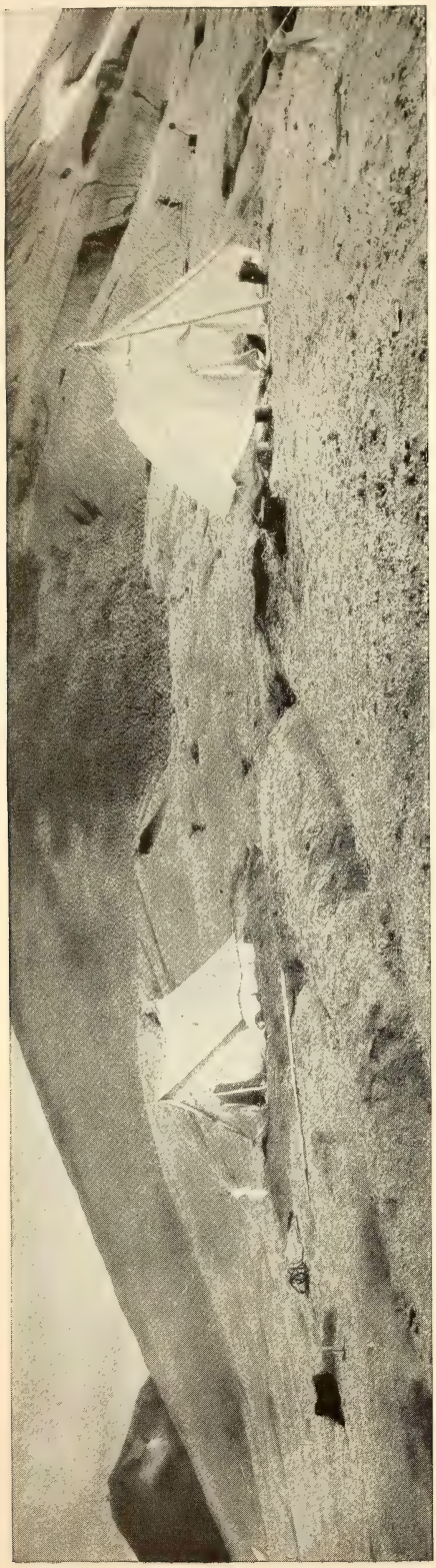
Having achieved the distinction of being the first explorer to ascend Mt. Katmai and study its active crater, the largest in the world, Mr. Griggs, in the GEOGRAPHIC *for January, 1917, gave a detailed account of the region in Alaska affected by the explosion of this mountain, which was the most tremendous volcanic eruption since the beginning of recorded history. In the present article he makes known to the members of the Society the wonders of the gigantic safety-valve area adjacent to Mt. Katmai, which he has named the Valley of Ten Thousand Smokes, discovered and explored by National Geographic Society expeditions.*

WHEN the members of the Katmai Expedition of the National Geographic Society, looking through Katmai Pass, first beheld below them the Valley of Ten Thousand Smokes, it was at once evident that one of the great wonders of the world had been discovered. The first glance was enough to demonstrate that we had found a miracle of nature which, when known, would be ranked with the Yellowstone, the Grand Canyon, and other marvels, each standing without rival in its own class (see also pages 131 and 147).

But in spite of the certainty which possessed us of the magnitude and importance of our discovery, further investigation at that time was impossible. We had been equipped for the definite task of exploring Katmai and reaching the crater of the gigantic volcano from which had come the tremendous eruption of June 6, 1912, one of the most violent in history.

For the accomplishment of this purpose our outfit had proved adequate. But the equipment was entirely insufficient to permit us to extend our lines across to the Bering Sea side of the range and maintain a camp in the Valley of Ten Thousand Smokes. Moreover, the time remaining to us was too short for the task, even if we had been adequately equipped.

As recounted in the GEOGRAPHIC for January, 1917, we were compelled, therefore, to turn back, with only the scantiest evidence to substantiate the story of our truly remarkable discovery. However,



Photograph by Clarence F. Maynard

STEAM-HEATED TENTS AT THE HEAD OF THE VALLEY OF TEN THOUSAND SMOKES

"When we turned in the first night we were astonished to find that the ground under our tent was decidedly warm. On examination we found that a thermometer thrust six inches into the ground promptly rose to the boiling point. This was indeed a surprise, for the place had been only recently vacated by the retreating snowbank behind us. We put most of our bedding under us to keep us cool!"

through the generosity of the Board of Managers of the National Geographic Society, funds for another expedition were provided, and during the summer months of 1917 we were able to continue the explorations of the previous year.*

THE TEN THOUSAND SMOKES A VAST SAFETY-VALVE

When we reached Katmai Pass, in June, 1917, I saw at once that everything was just as it had been the previous year. There were the two little fumaroles which we had first found, steaming away exactly as they had been the year before. This was decidedly reassuring, for I had been tormented with the fear that after all the time and effort spent in preparation for the expedition I might find that we had seen only a passing stage in the declining activity, and when we arrived we would find the valley dead, with all its volcanoes a thing of the past.

When I got back to camp and reported the conditions, I found that some other members of the party had been secretly entertaining the opposite fear—that the whole valley was likely to blow up suddenly while we were in it!

On the contrary, all that we have seen indicates that the activity of this district, like that of the Yellowstone Park, has reached a stable stage, which will continue without much change for a relatively long

* This was the fourth expedition sent by the National Geographic Society to investigate the stupendous eruption of Mt. Katmai. The first was in 1912, led by George C. Martin, of the U. S. Geological Survey, Mr. Martin's report, with 57 illustrations, being printed in the February, 1913, number; the second was in 1915 and the third in 1916, both directed by Robert F. Griggs, of the Ohio State University, whose report was printed in the January, 1917, number of the NATIONAL GEOGRAPHIC MAGAZINE, with 52 illustrations. To appreciate the number and magnitude of the discoveries made by the National Geographic Society expeditions, members should read again these reports. Extra copies of these interesting numbers may be obtained at 25 cents each.

period. Wherever we went conditions were the same. All the vents, big and little, are remarkably constant in their activity.

As long as steam continues to escape in such quantities, there appears to be little probability of a recurrence of any violent explosions like those of 1912, for the present activity of the region acts as a safety-valve to relieve the pressure from below and prevent its reaching the danger point.

FIRST VIEW OF THE TEN THOUSAND SMOKES

Last year Walter, who had been keeping camp the day we discovered the valley, had listened to our accounts of its wonders with polite incredulity. I was interested to see what the effect of really seeing the valley might be on an uneducated native with no scientific interest to spur him on.

When we had examined the little fumaroles in the pass and looked at the dozen or so of others round about, he turned to me with an air of "Well, I thought so all the time," and asked, "And is this the Valley of Ten Thousand Smokes?" "Oh! No," I answered; "that is over the rise yonder."

When we reached a point where we could see on down the valley, his amazement was unbounded. "Why," he exclaimed, "a whole big valley all full of smoke!"

I had planned merely to look in and turn back, for we had come a long way—so far that he had frequently remarked on the way up how far we had come and how fast I was walking, and had even asked to rest. But once he caught sight of the valley, he must go on. It was my time to call halt now, for I was thinking of the long way back to camp. But before I could stop him he had gone a couple of miles beyond the pass. He came home with shining eyes, very much excited, and though he was very tired he kept talking to Andrean about the wonder he had seen until late into the night.

How I wished I could have understood his Russian and heard exactly what sort of an impression the valley had made. I am sure his description must have been far more picturesque than anything I could write.

A WONDERFUL AND AMAZING SIGHT

It was indeed a wonderful and amazing sight that we looked upon, as we came into the valley from between the two lava mountains which guard the entrance. Nor had this marvel of nature lost any of its allurement in the interval that had passed since the one fleeting glimpse I had had of the phenomenon the year before.

As far as one could see down the broad flat-floored valley, great columns of white vapor were pouring out of the fissured ground and rising gracefully, until they mingled in a common cloud which hung between the mountain walls on either side. We could not see how far the activity extended, for about 5 miles down the valley the smoke had entirely closed in, cutting off any further view in that direction.

But we could look far up into the branches, which are given off to east and west from the head of the main valley. To the west the columns of steam could be seen coming out of the ground, close up to the base of the glaciers that wind down from the snowfields of Mt. Mageik, some four miles away. To the east our vision could not penetrate so far because of the prodigious activity in that quarter, where myriads of vents of all sizes were pouring forth immense quantities of smoke.

CROSSING THE MOUNTAINS AGAINST A HAIL OF PUMICE

It was four days later before all was in readiness for the whole party to go over. None of those who made that trip will ever forget it. The wind, which had been blowing uncomfortably hard for several days, freshened during the night until it began to carry away our dishes. The wind gauge in the sheltered nook we had selected for our camp showed a velocity of 25 miles per hour. Out on the mountain it was blowing twice as hard and directly in our faces. It was so strong as fairly to lift us off our feet at times; but worse than the wind itself was the hail of sharp pumice which it raised. The pumice cut like a knife whenever it struck our flesh. The others protected

Photograph by D. B. Church

SUNSET IN KATMAI PASS

The two little fumaroles to be seen at the right were the first of the millions of steam jets which the expedition discovered upon entering the majestic valley

their eyes with close-fitting goggles; but the leader could not avail himself of that relief because of the necessity of keeping to the trail, which in places was completely drifted over. Fortunately this lasted only round the shoulder of Observation Mountain, and from there on the going was comparatively easy.

We later found, however, that this was by no means an extreme wind for this region. On another occasion the men, after starting, were unable to make it and had to turn back. The wind gauge at the sheltered camp that day registered 60 miles an hour steadily, and much higher on the gusts.

MILLIONS OF VOLCANIC VENTS

When this year's party reached the valley, the effect on the men was stupendous. None had imagined anything nearly so wonderful. Every one agreed that no description could convey any conception of its immensity or grandeur.

I found that my matter-of-fact chemist was counting the smokes to see whether I had been justified in asserting that there were ten thousand of them. He soon announced that I was quite well inside the number. There are certainly many times ten thousand to be seen, even on a clear day, and when the weather is moist myriads more appear, for then the smoke from the millions of little holes whose gases ordinarily are invisible condense until there are a thousand times ten thousand.

One member of the party, who having traveled considerably and found many of the sights of the world overdrawn, was somewhat skeptical in advance about the Ten Thousand Smokes. When once he felt its thrall, however, he repeated over and over again, "Why, you couldn't exaggerate it." This statement is perfectly true. While the statistics of length, area, etc., could be falsified, the enlarged figures could no more convey any idea of the immensity of the new wonderland than can the real dimensions.

This is one of the greatest wonders of the world, if not indeed the very greatest of all the wonders on the face of the earth. The valley cannot be described; only after one has spent many days within its confines does one begin to grasp the proportions. All of these comments were made on first sight. We had not yet really seen the valley ourselves.

OVERAWED BY THE WONDERFUL VALLEY

The sensation of wonder and admiration, which came first to all, soon gave way to one of stupefaction. The magnitude of the phenomena simply overcame us. As we moved to any corner of the valley, what we had supposed from a distance to be little fumaroles turned out monster vents, each group more wonderful a spectacle than the whole, seen in panorama, so inconceivably vast is the volcanic region.

No amount of experience seemed sufficient to enable us to grasp proportions of this enormous safety-valve.

For the first few days we were overawed. For a while we simply could not think or act in the ordinary way. At night I would curse myself, as I lay in my blankets, and make a list of the things I wanted to do the next day; but when the morning came I could not move myself to action. I could only look and gape.

Shipley, the chemist, was easily the most self-possessed of the crowd. But for him we probably would have turned around and come home without any of the scientific material we had gone to collect. After all, the whole valley is very much of a gigantic chemical laboratory, and perhaps that accounts for his greater command of himself. Yet on the third day he remarked that "he did not feel like monkeying with his little bottles of chemicals."

X— was frankly scared to death. He did what I told him, but except when told to do something he sat in a dull-eyed stupor, like one at the funeral of his sweetheart, from which no efforts of ours could rouse him. I can only guess the effort it must have cost him to go up to the fumaroles and get pictures of them. He said himself that he expected to go crazy before he got out again. He had to be relieved and sent down to the lower camp before he regained his nerve, but in the end had as good command of himself as any of us.

Photograph by D. B. Church

PUTTING THE EXPEDITION'S SUPPER ON TO BOIL IN THE NATURAL STOVE OF THE VALLEY

There was no wood nearer than 15 miles from the camp at the head of the Valley of Ten Thousand Smokes, but the difficulties of cooking were solved by making use of one of the fumaroles from which steam constantly issued. It was possible to cook anything in this fireless cooker except fried bacon and flapjacks.

I was utterly unprepared for the feelings which thus overcame me. In 1916 I had not stayed long enough in the valley to get beyond the first sensations of wonder and admiration. I had by no means grasped the situation sufficiently to report it accurately. This region should have been named "The Valley of a Million Smokes," for there are certainly not one, but several millions of them all told.

FEAR OF CAVE-INS AND FUMES

A large factor in my feelings was plain fear. Perhaps I ought in honesty to say cowardice. The spectacle was so much bigger than I remembered it that I was badly scared by the job I had undertaken. The fear which beset me was twofold: fear of cave-ins and fear of the fumes.

As we explored the margin of the valley (the worst place, as we afterward found), we could plainly hear the ground ring hollow beneath the tunks of our staffs, and more than once we felt it shake beneath our blows. What if the ground should suddenly give way beneath our feet and precipitate us into a steaming caldron?

A breath of the steam from a vent blown around us for a moment by a chance breeze gave an uncomfortable burn. We knew that if once a man fell into such a place he would be instantly parboiled.

At first we roped up as for mountain-climbing and spread out, so that if one man went through, the others could pull him out. But when we came better to realize the conditions, we discarded the ropes, for we decided that if a man once got in it would be more merciful to leave him than to attempt to pull him out.

We had been assured by the best authority that there could be no danger from the fumes, but I had brought along a chemist partly for the express purpose of warning us as to what was not safe. I knew this valley to be different from every other place in the world, and reasoned that there could be no real basis for the assurances given me. What I feared was carbon monoxide, that colorless, odorless, tasteless gas, deadly even in concentrations as small as five parts in 10,000. It is usually present in the emanations from volcanoes. There is, moreover, no simple chemical test by which its presence may be detected. What if we should get a dose of that before we were aware of the danger?

But, like practically all the bugaboos which one meets in this world, these were proved by experience to be much less dangerous than our imaginations had pictured. Experience showed that there was always plenty of air to breathe, and we found no insidious gases likely to strike one down without warning, for our noses always gave us abundant notice of dangerous places, so that we suffered no injury beyond slight headaches and temporary inconvenience.

LEARNING TO TRAVEL SAFELY

So also with the cave-ins. As we grew familiar with the conditions we built up a basis of experience that soon enabled us to pick our way with some degree of safety. The deposits brought up by the fumaroles themselves so encrust their throats and the ground round about that a thin roof over a cavern will support a man with safety.

The worst places were those where fissures had been bridged over by ash and mud, so as to leave nothing to indicate their presence. After we had been in the valley several days we had some experiences with such places that probably would have turned us back had they occurred when we first arrived.

Several times, when we accidentally put a foot through a thin place in the crust, steam came spouting out of the hole, forming a new fumarole. But it was always one foot only and the owner did not take long to get out.

Once, while walking across a place that looked perfectly solid, I noticed a new hole midway between two old fissures and on investigating found that a steaming fissure two feet wide and ten feet deep was roofed over for fifty feet by a layer of mud so thin that I could perforate it anywhere by a slight thrust with my ice-ax.

But such experiences rapidly led us to perfect a sort of technique like that of the mountain-climber, which enabled us to choose the safest paths. Moreover,

Photograph by D. B. Church

WAITING FOR SUPPER ON THE EDGE OF THE STEAM OVEN

"As the pots were surrounded by an atmosphere of live steam, just at the point of condensing, nothing ever boiled away nor cooked to pieces, and no matter how long we forgot it, nothing ever burned. Everything was always done exactly right."

the first trip over the ground was the most dangerous. After one man had explored any area in safety, there was no probability of accident to those who followed.

COOKING AT A FUMAROLE

In many places the valley round about the vents is covered with a peculiar blue mud, thinly coated with a chestnut-brown crust, which sometimes supports one and sometimes gives way suddenly, letting one down to his shoe-tops in the soft, scalding mud beneath. At such times one is apt to feel that his feet are taking hold on hell in very verity, particularly if the place happens to look "ticklish" otherwise. We were surprised to find that continued immersion of our feet in such places did our shoes no perceptible injury, for we had expected that they would be rapidly eaten away.

We chose our camp well up on the mountain side overlooking the valley, close beside a melting snow-drift. Here, although we were denied the pleasure of a camp-fire, for not a stick of wood remains anywhere in the valley, we had "all the comforts of home." Fifty yards behind us was our refrigerator, where we could keep everything freezing cold until needed (see page 124).

Just in front was our cook-stove—a mild-mannered fumarole—into which we hung our pots to cook our food. We were somewhat dubious beforehand as to the feasibility of this method of cooking, because of the noxious gases that came off along with the steam; but the results were more than satisfactory. We never detected the faintest taint in any of our food. Everything was always done exactly right. Since the pots were surrounded by an atmosphere of live steam, just at the point of condensing, nothing ever boiled away, cooked to pieces, or burned, no matter how long neglected or forgotten.

There was only one drawback: while we were in the valley we had to do without our old standbys, bacon and flapjacks, for our stove would not fry. There were, however, many vents in the valley quite hot enough to fry bacon. The vapor from most of the more active ones is so hot that the steam does not condense for some distance beyond the vents (see page 133). When a stick is poked into these the end is quickly charred, indicating a temperature considerably above the frying point.

Our thermometers did not read high enough to measure the temperatures of these vents, so we were unable to ascertain exactly how hot they were. But we did not think it advisable to try bacon and flapjacks in them, because most of them are a little too vigorous to be altogether manageable. The vapor in many cases comes out with such force that the frying pan would have had to be held down against the rising steam. A sudden puff of wind from an unexpected quarter might, moreover, have blown the steam in the cook's face and inflicted a serious burn.

A STEAM-HEATED TENT

When we turned in the first night, we were astonished to find that the ground under our tent was decidedly warm. On examination we found that a thermometer thrust 6 inches into the ground promptly rose to the boiling point. This was indeed a surprise, for the place only recently had been vacated by the retreating snowbank behind us.

We put most of our bedding under us to keep us cool!

But before long our blankets were as hot as the ground. Close to the snow-drift as we were, and at an altitude of about 2,500 feet, the air was at times quite cold; so while we steamed on one side we froze on the other. We had to keep turning over and over in the effort to equalize the temperature. We did not sleep much the first night, and all expected to "catch our death of cold."

After a few hours we discovered that the ground was not merely hot, but that invisible vapors were everywhere seeping up through the soil. The condensation of this steam from the ground made our bedding first damp and then wet, so that by morning we were in a most curious case. The sensations that greeted us on awakening in these warm, wet beds can in justice be compared only with certain distressing memories of one's childhood days, which they exactly paralleled.

Photograph by Robert F. Griggs

OUR REFRIGERATOR

Just behind the tent was an ash-covered snow-drift that made an ideal refrigerator. The only trouble was that our larder was hardly equal to the accommodations afforded.

This state of affairs worried us very much indeed, for such conditions were the worst possible for the films on which we were depending to vouch for our story. By building a sort of crib with the walking sticks we had brought from the lower camp, we managed to keep them off the floor, and so reasonably cool; but in spite of all our efforts, they showed considerable deterioration before they could be developed.

Our instruments also took up water and swelled, so that we feared we should lose everything. A tripod, which had successfully stood the climate of a tropical-rain forest, jammed so hard that it could not be hammered loose. The cameras swelled until their focal points were shifted. A panoramic outfit upon which high hopes had been built refused to work and was altogether useless for the rest of the summer.

As I saw everything thus rapidly soaking up with water, I was very much disturbed over the consequences that would ensue when we should be caught in the rain; for, while our fumarole might be an ideal cook-stove, it was no good to dry clothes by. With a steamy tent there would be absolutely no way of drying our clothes after they were once wet. (Transportation was so difficult that we had brought no change of clothing.)

VAPORS OF THE VALLEY CURED RHEUMATISM

But in all these fears I was most happily disappointed, for we found that while everything soon became steamy damp in spite of all we could do, likewise anything that got sopping wet was soon reduced to the same moist condition. When we came in soaked through and chilled after a ducking, therefore, we found that the thing to do was to crawl into our blankets, and after a while both clothes and bedding would become as "dry" as when we started out.

Photograph by Robert F. Griggs

LOOKING ACROSS THE VALLEY FROM CAMP FIVE

The cloud of white steam issuing from the vent in the background is two miles distant

Photograph by Robert F. Griggs

A VIEW OF THE FIRST WONDER OF THE WORLD, FROM CAMP FIVE, AT THE ENTRANCE TO THE GREAT VALLEY, WITH ITS MILLIONS OF STEAM JETS ALWAYS IN ACTIVE OPERATION

The main valley is more than seventeen miles in length, but a complete view is never possible from any one vantage point, for so dense is the smoke that everything beyond five miles in any direction is hidden behind an impenetrable white pall

Photograph by Robert F. Griggs

STEAM COMING OUT ALONG THE LENGTH OF A FISSURE

"The marginal fissures usually stand open like great cracks in the surface, into which one might fall unless careful. If one tosses pebbles into the mouths of these vents they are so buoyed up by the rising gases that they are either immediately spewed out again or sink slowly down through the rising steam like feathers settling to earth" (see page 137).

In spite of the exposure to which we were daily subjected, there was not a sign of a cold or other illness in the party, but, on the contrary, the constant steaming seemed a good treatment for the rheumatic pains which usually develop on such expeditions. During our stay in the valley, and for some time after we left, we were as free from such aches as if we had taken the "cure" at a hot spring.

We came, therefore, to appreciate greatly our steam-heated tent, for we found it always warm and cozy, and there were times when the driving wind and rain outside were so bitter that we could hardly have endured the hardships otherwise.

THE WEATHER HAS MANY EVIL MOODS IN THE VALLEY

It would be a mistake, however, to suppose that with all our conveniences the conditions of our life in the valley were altogether ideal. The Alaska Peninsula is notorious as a storm-breeder, and before the eruption Katmai Pass had a reputation for bad weather not to be matched elsewhere on the American continent. Now, with such enormous quantities of hot steam rushing into the air close beside the extensive glaciers and snow-fields of the mountains, the weather is necessarily about as bad as could be.

From the head of the valley, where conditions made it necessary for us to camp, we could often look out of our door through a storm that threatened to tear the tent from the ground and see bright sunshine and good weather five miles down the valley.

There was rain almost every day we were in the valley—not the gentle mist familiar to dwellers of southeastern Alaska, but real rain in big drops, driven

Photograph by Robert F. Griggs

ONE OF THE BIGGEST VENTS IN THE VALLEY

Some idea of the size of this great earth seam, from which perpetually roll clouds of steam, may be gained when it is realized that the two black dots, indicated by the two arrows, are men standing at the edge of the opening

before the gusty winds that penetrated everything, until our tent roof looked like a basket. How we wished to study the valley from the shelter of a house with a real roof, where we could keep things dry and contemplate the wonders of nature with some degree of personal comfort!

But in the intervals between the rains the sunshine made up for all the hardships we endured. The weather here is somewhat like the little girl with the curl: "When it is bad it is undeniably horrid, but when it is good it is so very, very good" that one straightway forgives the evil moods. Whenever the skies cleared we instantly forgot the discomforts which we had endured, and one and all gave ourselves up to admiration of the surpassing beauty which surrounded us.

Having thus established ourselves in the valley, we proceeded to prepare for the study of the many scientific problems presented by this unique place.

One of the first peculiar discoveries made by us when we arrived in the valley was the great number of dead insects around the vents, where they had been killed by flying into the live steam. Hine, therefore, came up for a few days to study the insects with the purpose of ascertaining how they get into the valley and where they breed (see page 135).

The larger animals are practically absent, but we found occasional tracks of bears, wolves, and wolverines, which had crossed the valley from one range to the other.

Most of these were old, but one day I found the tracks of a bear which had crossed during the night. I wish I could have watched him when his feet sank into the patches of soft, scalding mud that lay in his way. He must have been treated to the surprise of his life! But however he felt, he kept right on straight across the valley, without making the slightest deviation to avoid the bad places, often sinking deep into the hot mud (see page 152).

Maynard, with one of the others for assistant, toiled up to the summits day after day with 30-pound packs to secure the topographic map which is the necessary basis for all our statements of areas and sizes. His was arduous work and the effort was often wasted, for the days when the mountain summits are perfectly clear, as is necessary for this work, are rare around mountain passes anywhere, and here especially so.

Sometimes the weather seemed to have an almost fiendish power of opposing their plans, for several times from the valley we could watch and see a thin cloud hanging all day to the very summit, on which they stood shivering, while the other mountains all around were clear. More than once it seemed as if there would not be enough clear days to complete the observations, but in the end they succeeded in getting the data for an excellent map.

PRACTICALLY ALL PLANT LIFE DESTROYED

The most disagreeable, as well as one of the most difficult, tasks fell to Shipley, who collected samples of gas from the vents for analysis, from which it is hoped to learn much about volcanoes in general and those of this district in particular. In laying out work in advance, to poke a glass tube into a vent and pump the gas into a collector sounds easy, but in the field all sorts of difficulties crop up which require great patience and resourcefulness to surmount. Apparatus will not do what is expected of it; tubes clog prematurely or snap in the heat.

Moreover, a volcano is not an easy customer to deal with at close range. When, after some trouble, one is in a position where he can get his sample, and a sudden shift of wind brings a cloud of hot, blinding gas around him, he is placed in a difficult, not to say dangerous, situation. More than once our gas collectors became lost, but fortunately the precious samples were all secured without mishap and a considerable amount of other valuable chemical work done.

Only the botanists were without employment, for in the formation of the valley all life was completely annihilated and plants are practically absent. Not quite so, however, for around some of the vents moss and algæ are beginning to start where bathed by the warm breath of the fumarole, from which they derive, beside the constant moisture, their supply of nitrogen in the form of ammonia,

Photograph by J. W. Shipley

MOUNT CERBERUS, LYING STRAIGHT ACROSS THE HEAD OF THE VALLEY, RESEMBLES A CROUCHING ANIMAL GUARDING THE ENTRANCE TO HADES

This mountain is practically surrounded by fumaroles emitting jets of steam (see also page 140)

which is given off in considerable quantity by the vents.

The beans we dropped on the "kitchen floor" near our fumarole also sprouted and grew rapidly on the warm ground, soon making a bright spot of green; but they were short lived, for the roots were killed wherever they touched the acid soil.

The absence of vegetation gave me opportunity to spend all of my leisure in studying the manifold geological problems of the place, which presents a remarkable and unique exhibition of geological forces.

A COMPLICATED SYSTEM OF SMOKING VALLEYS

The area in which the vents occur is not a simple valley, but includes a complicated system of branches, the whole forming a tract of very irregular shape. The main line of activity extends directly transverse to the axis of the Alaska Peninsula from Katmai Pass northwestward toward the head of Naknek Lake. In this direction vents occur all the way down the valley as far as the bend to the north. There is clear evidence that when the steam jets burst forth this line of activity also extended straight across the pass and down through the upper valley of Mageik Creek to Observation Mountain.

As one ascends this main valley from the Bering Sea side, he sees lying straight across its head a mountain resembling a crouching animal guarding the entrance. This mountain, which we thought appropriate to call Cerberus, is practically surrounded by fumaroles, for a small branch valley runs around from the pass. In front of Mt. Cerberus the valley is very wide, sending a short branch westward under the glaciers of Mageik and another longer one to the east toward the crater of Katmai (see page 140).

In the latter branch the climax of the activity of the whole district is to be found in the two remarkable features described below—Falling Mountain and Novarupta Volcano. We were astonished to find that this branch has no head, but continues round by Mt. Katmai and back to the main valley under the slopes of Knife Peak.

The mountains, thus surrounded by a complete ring of vents, are so cut up by faults that we named them the Broken Mountains. They are bisected by a smaller branch valley, also full of vents, stretching across from Novarupta. Activity occurs in yet another branch on the opposite side of the main valley well down toward the bend. The total length of all of these smoking valleys is 32 miles. The area is 70 square miles, the average width being 2 miles.

Photograph by J. W. Shipley

EXPLORING A STEAMING FISSURE

With the steam so thick that one cannot see his way, one often wonders where he is coming out

COMPARISON WITH THE YELLOWSTONE PARK

With these dimensions at hand, it will be interesting to compare the valley with the Yellowstone Park. In the Yellowstone there are about 4,000 hot springs and a hundred geysers scattered over an area of some 3,000 square miles. The geysers, which are the most interesting feature, occur in several isolated geyser basins, whose total area is hardly 20 square miles. The largest of the geysers, which play but seldom, shoot up a column scarcely exceeding 300 feet in height. The column of Old Faithful, which is the only geyser the tourist can count on seeing in action, is about 100 feet high.

In the Alaskan Valley there are in constant action thousands of vents whose columns exceed that figure. The columns of several of the largest vents may, when conditions are right, ascend more than 5,000 feet into the air or, under the influence of the winds which sweep the valley, trail along the ground for two or three miles.

WHY THERE ARE NO GEYSERS

One of the questions most frequently asked by persons interested in the region is whether or not there are geysers.

Photograph by Robert F. Griggs

A TYPICAL MUD CANYON IN THE VALLEY OF TEN THOUSAND SMOKES

These curious, twisting gorges, though only a few feet wide, were often 60 feet deep

Photograph by J. W. Shipley

INSPECTING THE CAVERNOUS MAW OF A GAS-EMITTING VENT

The gases from these openings are transparent until they begin to condense in the atmosphere. Therefore it is frequently possible to look into the depths of the earth for many feet.

None was observed, and the conditions are such as to make their development unlikely for the present. Geysers belong to a declining stage of volcanic activity, while the present region is in a youthful stage. A geyser consists essentially of a column of hot water mixed with steam, which is periodically projected into the air by the sudden formation of the steam from water gradually heating up to the boiling point.

A geyser can exist, therefore, only in rock cool enough to permit the accumulation of the water. The vents of this steaming valley are so hot that they would instantly vaporize any ordinary quantity of water that might find its way into them. One can readily see that if the valley cools off gradually there may come a time favorable for the formation of geysers.

To attempt any catalogue of the individual vents or any description of them would be utterly futile. They vary all the way from microscopic jets of gas to mighty columns of smoke which overtop the mountains. To explore the valley thoroughly and become acquainted with the characters of the various vents would require a residence of several months. We were continually surprised to find new and interesting features in places with which we thought we were perfectly familiar. The smokes in general, however, may be classed as coming either from craters or fissures.

THE CRATERS OF THE PLAIN

The craters are much less numerous than the fissures, but include some of the largest and most active of the vents. All of them are located in the floor of the valley, not around the edges. They average about 100 feet in diameter. The rims are slightly raised above the general level, showing that they were produced by explosive action (see page 135), but the amount of material in these crater rings is, in general, very much less than enough to fill the cavity. Within they are perfectly conical pits, sloping down into the throat at the bottom.

The steep sides, standing at the critical angle, remind one of the pits which ant lions dig in the sand. Indeed, little imagination is required to picture the old devil at the bottom waiting to devour whatever slips over the edge; for the sides are so nearly perpendicular that if any one made the first slip he could never get out again.

The smoke from these craters comes out in such volume that often the hole is completely filled and its outlines concealed, but by waiting a few moments at the windward side one can usually see the inside of the crater, and sometimes for an instant catch a glimpse of the throat at the bottom—usually a perpendicular tube about 10 feet in diameter leading down into the bowels of the earth. On favorable occasions one may see as much as 50 feet below the surface of the plain; but these momentary glimpses did not give us much information as to the character of the rock at that depth. We could not even be sure whether it differed from the surface mud.

Many of the craters stand apart from other vents. In other cases they are grouped together in areas with few fissures. In a few places the evident relations between craters and fissures furnish perfect models of the relations generally believed to underlie the great lines of volcanic activity that girdle the world. In such a place a long fissure has here and there thrown up craters around points of special activity, forming lines of craters standing up out of the fissure and locally obliterating it without concealing their relations to it.

In the same way such a series of volcanoes as the Aleutian chain, of which the present district is a part, are supposed to be built up around the openings from a continuous fissure in the earth's crust, extending for several hundred miles throughout the length of the chain.

THE FISSURES

Much the greater part of the steam in the valley comes to the surface, not in these craters, but through the innumerable fissures. There are readily seen to be two sets of these—bands of marginal fissures, several together, running around the edge of the valley in parallel lines, and single central fissures, which crisscross the floor in all directions (see pages 125 and 126).

Photograph by L. G. Folsom

THE MOUTH OF A VENT IN THE SIDE OF A GULLY

The entomologist with his bug net seems incongruous in such a place, but around some of the vents there are thousands of dead insects, killed by flying into the hot steam

Photograph by D. B. Church

SMOKING FISSURES AT THE FOOT OF FALLING MOUNTAIN

"To convey an adequate impression of Falling Mountain, the record of a phonograph rather than of the camera would be necessary; for in a period of maximum activity there is a continuous series of bangs, thuds, and rattles, as masses of rock of all sizes are loosened from their hold and roll down the two-thousand-foot slopes of the mountain."

The marginal fissures usually stand open, like great cracks in the surface, into which one might fall unless careful. Sometimes the fissures were formed merely by the cracking open of the ground, but often they are lines of faulting, one side standing higher than the other. They are often steaming hot for long distances without a break, and at intervals contain vents from which issue some of the biggest smokes in the valley.

While the smoke from the craters comes out quietly, in vast, rolling clouds, that from the fissures often is emitted under considerable pressure, roaring and hissing. If one tosses pebbles into the mouths of these vents they are so buoyed up by the rising gases that they are either immediately spewed out again or they sink slowly down through the rising steam like feathers settling to earth. Such vents are the hottest places in the valley; the gases from them do not condense for several yards beyond the orifice (see page 127). They furnished some of the most satisfactory places for the collection of gases for analysis, because of the ease with which the collector could assure himself that his sample was free from contamination with the atmosphere.

The fissures of the central valley floor, unlike those along the margin, do not stand open, but are often recognizable only by the lines of incrustations deposited along them. Although they also contain some of the largest vents, the gas from many of them is not visible on a bright, hot day, and only during wet weather does one realize, by the long lines of little smokes he sees stretching across the valley in every direction, how much gas such fissures are continually pouring out into the air.

Naturally we were anxious to find out how deep some of these fissure were, but we could not gratify our curiosity. To sound some of the less active vents with a stone tied to a rope was easy, but this line was only 100 feet long and was too short to reach the bottom of those we tried.

The greater part of the gas given off is undoubtedly steam, but even the smaller vents contain many substances, in addition, which must have originated deep down in the earth. In many of the larger and hotter vents the proportion of other gases increases so greatly that the emanation is changed in character and does not look like steam, but takes on a bluish cast like the smoke from the combustion of a fire. In a few cases this blueness is so pronounced as to be noticeable at a distance of several miles.

The principal cause of this blue smoke appears to be sulphur dioxide, the same gas that is given off by burning sulphur. Other factors probably coöperate in producing this appearance, but in what degree they are responsible cannot be determined until the chemical analyses are completed.

A BEWILDERING COMPLEX OF ODORS

The many substances rising through these vents result in an extremely curious combination of odors, which Dr. Shipley, with the trained nose of a chemist, thus describes:

"As we entered the valley along a deep, dry, watercourse, we observed, from time to time, a peculiar, indefinable, and not unpleasant odor. Passing close to the active vents, the odor of hydrochloric acid and hydrogen sulphide could be detected easily. From certain of the active areas a disagreeable smell, unlike any odor that we had ever encountered, arose. It was somewhat suggestive of a pigsty, a horse-stable, and sewer gas, yet we could not relate it definitely to any previously observed smell.

"Whatever the gases are, that rise from the vents in the floor of this wonderful valley, collectively they offer a considerable task to the olfactory organs in differentiating the known from the unknown. At a distance of 20 miles from the valley, one was certain one moment that the gas was sulphur dioxide which the wind bore to him, the next moment it was hydrogen sulphide, and the next, both or neither. This same elusive uncertainty clung throughout the whole period of our stay in the valley. It was only in the vicinity of a vent that the individual gases could be identified with certainty by the sense of smell."

All of the vents, even the smallest, whose fumes are too slight to be visible,

Photograph by Robert F. Griggs

THE LAVA PLUG OF NOVARUPTA FROM THE CRATER RIM

"Novarupta apparently began with an explosive violence surpassed in this district only by Katmai itself. . . . After explosive activity had ceased there was a slow extrusion of pasty lava from the vent. This has been pushed up until it forms a great plug of lava. Its surface is covered with an indescribable confusion of fragments of all sizes, shapes, and colors. We could only guess how far it might be through this mantle of fragments to the still molten lava beneath."

incrust the mud in their vicinity with copious deposits, giving the adjacent ground a most fantastic appearance. These incrustations take on all colors imaginable and in many places give rise to very beautiful formations. The prevailing hues are perhaps those due to the gray and green and yellow alums, which build out curious crystalline structures simulating lichens growing on the ground.

DEPOSITS ALL COLORS OF THE RAINBOW

Over large areas the ground has been burned to a bright red by the heat. The variations in the intensity of the color produced are extremely beautiful, including, as they do, all shades from orange and brick red to bright cherry reds, purples, and on down to black, with occasional contrasting streaks of blue. This type of coloration is most pronounced in areas originally occupied by small fumaroles which have burned out. In places the ground has the appearance of having been burned with fire for a mile at a stretch.

Around the larger vents the ground is more commonly colored a dull pink by a deposit which cements the loose, sandy particles of ash into compact masses like concrete. In some of the largest vents such pink and red incrustations are the only ones developed, but more often spots of brilliant yellow and orange also occur in beautiful contrast with the pink ground color.

FLOWERS OF PURE SULPHUR

These yellows are mostly due, of course, to sulphur, which is very common. There are some places where one can gather crystals of sulphur, almost free from impurities, by the bushel. And up on the mountain side above the crater of Novarupta is a great yellow spot of sulphur conspicuous for miles. Sulphur occurs most often in small crystals compacted into solid cakes, but occasionally we found it lining the throat of a fumarole in long, branching, needle-like crystals (flowers of sulphur), very beautiful under a lens.

With the yellow sulphur are often deposited masses of a bright orange crystalline substance whose composition we did not know. These are generally deposited in the cracks of the characteristic blue mud that abounds around many of the groups of fumaroles, especially in places where there is considerable diffused activity, reaching the surface through innumerable small jets rather than by a single large vent.

Needless to say, the color combination presented by the orange and blue is as beautiful as it is unusual. In similar fumarole groups where the activity is not quite so intense the surface of the same blue mud is covered with a rich chestnut-brown crust, whose varied tones would of themselves excite the highest admiration were they not eclipsed by the other more brilliant colors.

In still other places the prevailing deposits are of a white, chalky character, recalling the geyserite of the Yellowstone Park. These white vents excel all the others in the delicacy of their coloring, for they are lightly tinged with yellow and pink, giving them a creamy, flesh-colored appearance, even more beautiful than the brilliant masses of color elsewhere developed.

In addition to all these colors, algæ have formed a deep-green incrustation over the ground close up to some of the vents, in places where at first sight one would suppose the ground was too hot to permit the activities of organisms of any kind; but the insulating properties of the soil are so good that great variations in temperature may occur within a few inches.

We much desired to make accurate color studies of the characteristic deposits, but the time at our disposal was altogether too short to permit of such detailed exploration. Indeed, it should be emphasized that there is material in this wonderful valley to repay months of careful study, and that all we could do was to examine hastily the major features, leaving thousands of important seats of activity without even so much as a cursory visit.

But there are a few special features which cannot be passed by without more detailed description.

FISSURE LAKE

Across the head of the valley stands the three-peaked bulk of Mt. Mageik, smok-

Photograph by C. F. Maynard

PANORAMA OF THE VALLEY OF TEN THOUSAND SMOKES, LOOKING FROM BROKEN MOUNTAIN

From left to right: Mt. Katmai, Novarupta (see page 145), whose smoke conceals Trident and Falling Mountain (see page 141); Katmai Pass, Mt. Cerberus (low), Mt. Mageik, and Mt. Martin, whose smoke is barely visible

ing away continuously into the clouds far above. Down its sides tumble three magnificent glaciers broken to fragments by the steep descent. The tongues of all three come down to the level of the valley, where they stop abruptly without moraines, as though melted back by the heat.

Near the foot of these glaciers occurs the most conspicuous fissure to be found anywhere in the valley. It is 200 to 400 feet wide, with perpendicular walls, one of which stands about 35 feet higher than the other. The depth could not be ascertained because it is filled by a beautiful lake of clear, green water. Standing just at the foot of the glaciers, this fissure is one of the most picturesque spots in the whole valley (see page 146). Along the sides are numerous snow-drifts, from which miniature bergs break off and float away in the clear water.

WARM WATER FROM SNOW-DRIFTS

Fed by the glaciers and melting snows, Fissure Lake would be expected to be icy cold, but on the contrary it is decidedly tepid in spots, where heat evidently is received from below. One of the most amusing incidents of the whole trip occurred when our chemist, poking his thermometer into everything, discovered this fact.

I was coming along a little behind, and he, pretending to need my assistance, asked me to tell him the temperature of the water coming out from under the edge of a snow-field. Willing to answer even a foolish question, I had the words "ice cold" on the tip of my tongue when my fingers touched the water. The speaking expression froze on my face and I carefully dipped my hand in again. It was actually warm! How he did laugh at my discomfiture!

The snow-fields which surround the valley send trickling rills down the slopes, but these dry up and disappear long before the floor of the basin is reached. From the glaciers, however, comes a considerable stream, which runs, in spite of all obstacles, clear through the valley, dwindling to almost nothing before passing out of the hot area. These waters thus so nearly forget to run that we christened the stream the River Lethe.

Photograph by Robert F. Griggs

FUMAROLES ALONG THE RIVER LETHE

Here is a place where one could easily cook his fish without taking it off the hook—if there were any fish to catch. In places the steam actually bubbles up through the cold water.

The appropriateness of this name is increased not only by its course, which lies through the center of Hades, but also because the uncanny waters, full of deep-brown silt from the glaciers, have a most weird aspect as they rush swirling down the valley.

WHERE YOU COULD COOK YOUR FISH WITHOUT TAKING IT OFF THE HOOK

In many places the river cuts straight across lines of volcanic activity, and here we see how close the antagonistic elements—"fire" and water—may approach one another without disturbance. The mud, which lines the banks, is so perfect a non-conductor that within a few inches of the cold water the ground is boiling hot. There are places where the steam from small fumaroles actually boils up through the water of the river! Several good-sized vents are located on the very banks of the river.

Here one could catch a fish in the stream and cook it without taking it off the hook—if only there were any fish, for one can hardly imagine fish frequenting this murky stream. There is, however, no real reason why they might not occur; for, in spite of the fact that the very banks are boiling hot, the waters maintain their glacial temperature of about 48° F. throughout the valley.

The climax of activity in this wonderful valley occurs in the northeast angle, toward Mt. Katmai, where there are two features of surpassing interest—Falling Mountain (see page 136) and Novarupta Volcano (see page 138).

FALLING MOUNTAIN

At first sight, Falling Mountain looks no different from other lava mountains near by, except that one face is a perfectly fresh rock cliff without any covering of ash. On account of the quantity of surrounding steam, one is not apt to notice that this rock face of the mountain

Photograph by Clarence F. Maynard

PANORAMA OF THE VALLEY OF TEN THOUSAND SMOKES, FROM BROKEN MOUNTAIN, SHOWING ESPECIALLY WELL THE "HIGH MUD MARK" AND THE GRADIENT OF THE MUD FLOW

is steaming like the ash fissures in the valley. As one comes up the valley, therefore, he will give scant notice to this mountain until his attention is forcibly drawn to it by the big fall of rocks which is sure to occur within a few minutes. Then he will turn away for a minute or two, only to have his attention brought back again by another rock fall.

After one has spent some time near the mountain and on repeated visits always hears the same thunder of the continuous rock falls, the realization gradually dawns on him that here is a feature as remarkable as any other in the valley; for when one's interest is aroused to inquire as to the cause of the phenomenon he begins to see that such a continuous series of rock falls could not be produced by any ordinary agency.

To convey an adequate impression of Falling Mountain, the record of the phonograph rather than of the camera would be necessary; for in a period of maximum activity there is a continuous series of bangs, thuds, and rattles, as masses of rock of all sizes are loosened from their hold and roll down the two-thousand-foot slopes of the mountain. Always the sound rather than the sight draws the attention, for one often has to look very hard before he can find the rocks that make the noise, so high up on the broad cliff do they start.

HUGE ROCKS SHOT FROM THE MOUNTAIN

The rocks which one is apt to see thus in a casual visit vary in size from small stones to boulders weighing several hundred pounds, but the aggregate fall in an hour reaches several tons.

At the base of the mountain are much larger masses of rock which have come down from above like the smaller ones. The largest of these is a steep-sided conical pile, measuring 500 feet in circumference, which stands out in the floor of the valley a hundred yards beyond the end of the talus slopes. There are several others nearly as large and similarly detached from the talus slopes, where most of the material lodges.

As one looks at these huge piles, made up of fragments of loose rock, dropped as though spilled from same aërial cableway in this great mine of the gods, he

Photograph by Clarence F. Maynard

HALF WAY DOWN THE VALLEY OF TEN THOUSAND SMOKES, LOOKING TOWARD KATMAI PASS FROM AN ELEVATION ON THE EASTERN SIDE

cannot fail to wonder how they could have reached their present position. Lying, as they do, on top of the ash, they evidently have been deposited there since the eruption. As one looks around for a source, he is strongly inclined to suspect that these immense chunks were shot out from the mountain directly to their present position, without a preliminary roll down hill, which surely would have dissipated the fragments and have left a tremendous furrow behind, where they rolled across the soft mud in which they lie.

As one approaches closer to the foot of the mountain he sees other evidence which adds weight to this hypothesis. Along the base of the mountain is a deep, wide fissure, that would stop any of the rolling stones, which, indeed, seldom reach it. But beyond this fissure are many rock fragments of all sizes. Among these are also found the marks where they struck, deep cuts into the ground. Some of these are quite fresh, so that as one walks among them he watches the precipice above apprehensively, with a view of dodging any missile which may come his way.

STEAM ISSUES FROM SOLID ROCK

Some of these pieces are still solid rock, but others have completely disintegrated into small fragments since their discharge from the mountain. The appearance of these fragmented rocks is very similar to that of rocks which have spawled under great heat or broken up after the repeated effects of freezing and thawing, but the disintegration is very much more complete here than one sees in such cases. These rocks look, therefore, as if they had been broken up by forces within themselves.

When one has made this observation he looks with renewed interest on the steam escaping from the solid rock above and turns to the large piles from some of which steam is still escaping in considerable volume (see page 136). An examination seems to indicate that the steam comes from within the piles themselves, rather than from the ground beneath; but most of these are so covered with loose fragments that it is difficult to observe the origin of the steam. We

Photograph by D. B. Church

A PORTION OF THE ROCK SLIDE FROM THE SLOPES OF NOISY MOUNTAIN

Unlike Falling Mountain, one of the phenomena of the Valley of Ten Thousand Smokes, Noisy Mountain, in the upper Katmai Valley, gives off no steam, yet there is a constant rumble of falling rocks from its sides. Note the conical piles of rock in the middle distance (see page 143).

found places, however, on these piles clean of all debris, where steam could be seen issuing directly from the solid rock, just as one sees it high up on the mountain side.

If such evidence were sufficient to permit one to draw positive inferences he might conclude that Falling Mountain is really a mild sort of explosive volcano in which the explosions occur in solid rock rather than in liquid lava. But the presence of a similar active mountain in upper Katmai Valley (Noisy Mountain), from which no steam issues, would make one hesitate in drawing such a conclusion. A more critical study of these curious mountains than was possible, with our limited facilities, ought to yield valuable results.

NOVARUPTA VOLCANO *

Directly opposite the precipices of Falling Mountain lies Novarupta, the greatest of all the vents in the valley. This, though newly formed at the time of the big eruption, is one of the world's largest volcanoes. It is, indeed, a new volcano, differing materially from most of the "new" vents that appear, in that it is not located on the top of an old volcanic mountain, which had erupted before and was in reality only dormant (see p. 138).

On the contrary, it burst through in a new place along the margin of the old volcanic complex, appearing not in igneous rock, but in sedimentary sandstone adjacent to former igneous extrusions. This vent is located not on a mountain top but in the bottom of a valley, which before the eruption gave no indication of the volcanic forces beneath.

Novarupta apparently began with an explosive violence surpassed in this district only by Katmai itself, for quantities of its pumice are scattered over an area ten miles in diameter, forming deposits in places more than fifty feet deep (see page 145). In these deposits cinders

* The name suggested by Mr. Folsom is here published for the first time.

weighing upward of a hundred pounds are frequent, and everywhere the ejecta are much coarser than the ash from Katmai, indicating that the explosions were less violent.

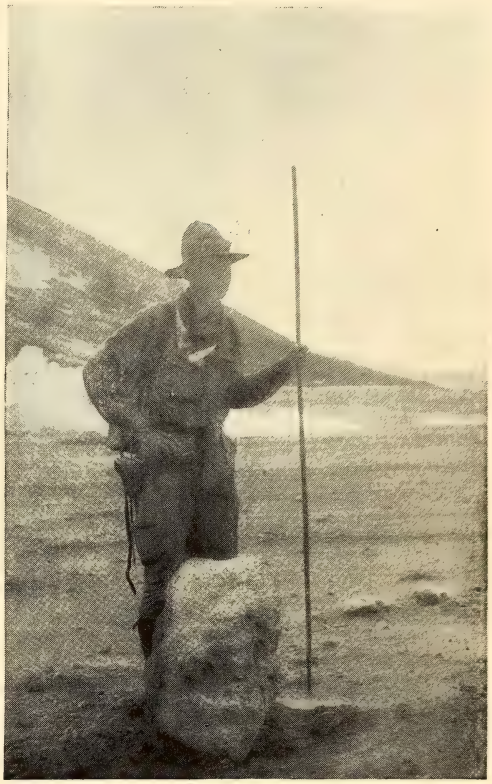
After the first violent outburst the activity apparently gradually diminished in intensity until most of the ejected material was thrown only a short distance, forming in its fall a circular crater ring immediately surrounding the vent. This being seven-tenths of a mile in diameter, is one of the largest explosion craters in the world, very much larger than Pelée or Vesuvius, and would be a feature of primary interest in the region were it not dwarfed by the vast crater of Katmai.

THE GREAT LAVA PLUG OF NOVARUPTA

As the explosive period drew to a close the lava became more and more pasty, until among the last stones thrown out were numerous masses of lava stiff enough to retain their shape, yet so hot that their surface is cracked open from the contraction incident to cooling, giving the characteristic "bread crust" appearance. These are the only lava "bombs" found in the Katmai district. Nowhere are there any typical bombs formed by masses of lava thrown out while still liquid and assuming a rigid spheroidal form while still in the air. Indeed, nowhere else were even "bread crust" bombs found.

After explosive activity had ceased there was a slow extrusion of pasty lava from the vent. This has been pushed up until an immense plug of lava has been formed 1,200 feet in diameter and 250 feet above the floor of the crater. The surface is covered with an indescribable confusion of fragments of all sizes, shapes, and colors, formed by the fragmentation of the lava from the strains set up by unequal contraction while cooling.

We could only guess the distance through this mantle of fragments to the still molten lava beneath. The fact should be noted that nowhere in the whole district did we see any evidence of a lava *flow* in connection with the present eruption. This mass of rock, which from the beginning was evidently very pasty, is the nearest approach to molten lava to be found in this region.



Photograph by Robert F. Griggs

A CHUNK OF PUMICE THROWN OUT BY NOVARUPTA

So violent was the explosion of Novarupta that quantities of its pumice are scattered over an area ten miles in diameter. In these deposits, cinders weighing upward of a hundred pounds are frequent (see page 144).

That somewhere beneath the surface of this plug the lava is still molten is abundantly evidenced by the tremendous quantities of smoke continuously given off. Often this cloud fills the sky for miles, even drifting through Katmai Pass and obscuring considerable areas on the other side of the range. At other times the smoke forms an erect column as much as two miles high (see page 140).

Around Novarupta the earth is all shot to pieces with more and larger steaming fissures than are to be found elsewhere, so that only with difficulty one finds a path through the bewildering maze of vents. The climb over the rim of Nova-

Photograph by J. W. Shipley

A FUMAROLE ON THE BANK OF FISSURE LAKE

"Near the foot of three glaciers occurs the most conspicuous fissure to be found anywhere in the valley. It is 200 to 400 feet wide, with perpendicular walls, one of which stands about 35 feet higher than the other. Its depth could not be ascertained because it is filled by a beautiful lake of clear, green water. Along its sides are numerous snow-drifts from which miniature bergs break off and float away in the clear water. Fed by glaciers, one would expect Fissure Lake to be icy cold, but, on the contrary, it is decidedly tepid in spots, where it receives heat from below."

rupta and down beside the plug of lava is the most fearsome adventure afforded to the explorer of the valley, for here there is so much steam that he is more than likely to be surrounded in a hot cloud, blown by the fickle wind. Two of the party so surrounded in this vicinity once became completely confused, disagreeing as to the way home, and finally taking the wrong course until they were set right by crossing the trail made by a previous party.

VALLEY OF TEN THOUSAND SMOKES WITHOUT A RIVAL

In order that the reader may justly estimate the status of this valley among the wonders of the world, we ought to make some comparisons with other similar regions, but in truth there is no other region with which the Valley of Ten Thousand Smokes can be compared. Niagara finds a rival in Victoria Falls. The Rotorua district of New Zealand is a competitor of the Yellowstone. The Crater of Katmai must stand comparison with Kilauea and Crater Lake.

Not so with the Valley of Ten Thousand Smokes. It is unique. *Nothing approaching it has ever been seen by the eye of man.* To find a parallel we must search the records of geology, for here we have such a volcanic outburst as the geologist finds recorded in the rocks of the past, but never before has had an opportunity to observe in the world of the present.

In the size of the vents and the quantity of smoke given off the valley is so far beyond other volcanic districts that no other place can for a moment be compared with it. Quite well within the truth, we might say that the sum total of the emanations from all the other volcanoes of the American continent, from the Aleutians to Patagonia, except during rare periods of a dangerous eruption, is much less than is given off within the radius of one's vision from the Valley of Ten Thousand Smokes.

Indeed, if one could pick up all the other volcanoes in the whole world and set them down together, side by side as close as they could stand, they would present much less of a spectacle, always excepting a period of dangerous eruption, than does the Valley of Ten Thousand Smokes every day in the year.

THE LAST DAY IN THE VALLEY

I can never forget my last day in the valley. We had been lying in our sopping tents for two days, unable to stir outside in the blinding storms. The rest of the work was pressing, for I had already overstayed the time allotted for the valley. In the morning I had announced that we would move out that night, regardless of the weather, and had given orders for the equipment to go down. We started out for some last pictures in rain and mist which made it impossible to find our way around through the steam, but after a couple of hours there came a break.

The atmosphere cleared and disclosed the sun shining out of a blue sky, spotted with big cumulus clouds, with a light that was dazzlingly bright. I never saw the valley half so wonderful. We exposed our films as fast as we could wind them up, getting within a few hours many of our best pictures. There were a dozen showers during the day, soaking rains, too, but we utilized such intervals to travel from one group of vents to another. We came in at 6 o'clock tired out, but bent on taking out the big photographic outfit for the one grandest panorama of all. But it was too late; because of my own orders we found the camp stripped of everything we needed.

There was nothing to do but follow, so we made up our packs and reluctantly trudged out through the pass and down the other side. I almost wept as I turned for one last look at the marvelous valley, showing off now as never before, for as we came up to the divide, which we were perhaps never to cross again, a magical curtain was unrolled, as a background for the scene, in the most gorgeous sunset I ever saw. The wonderful colors held us almost spellbound for hours, until they slowly faded into twilight, as we rounded the shoulder of Observation Mountain into Katmai Valley.

TESTIMONY OF MY ASSOCIATES

At my request various members of my party have written a brief summary of their impressions, as follows:

Photograph by Robert F. Griggs

A "BUTTE" IN THE VALLEY OF TEN THOUSAND SMOKES, FORMED OF SOLIDIFIED MUD

Paul R. Hagelbarger, Assistant Botanist.—"Bright sunshine bathed the valley when I first saw it. Even though several miles away, I was awe-struck by the surprisingly large size and striking beauty of the spectacle. There were so many more steam jets than I had even hoped to see that I could only gaze in silent admiration.

"After living in the valley and working among the fumaroles, my impressions began to change. My amazement at the great area was intensified by the knowledge gained on many trips across the valley floor. The beauty of each individual vent was even more than that of the valley as a whole.

"The thing that stupefied me, however, was the ever-present proof that some terrific energy or force had only recently exerted itself. Everything seemed on such a huge scale. Our tents looked insignificant, pitched among the gaping fissures and the roaring volcanic vents.

"As I came daily to know the area better, I was more and more impressed by

the titanic forces that had been at work here. Human endeavor and achievement seemed dwarfed to insignificance by comparison. I felt out of place and like an intruder in this Land of the Gods. This valley appeared to be on another planet that was in the process of formation.

"I spent 16 days in the valley and was glad to leave, as will be seen in my diary for August 2: 'Came out of the steaming valley for good. Lucky to get out. Glad to see trees and grass again. Feel like I am just awakening after a two weeks' nightmare. Valley is wonderful, but no place to camp. Walter says, "Lots of steam. Hell of a place." Heartily agree.'"

Photograph by J. W. Shipley

HOODOOS IN THE SOLIDIFIED MUD, CAUSED BY FAULTING

SURPASSED HIS WILDEST DREAMS

J. D. Sayre, Assistant Botanist. — "My sensation on first seeing the Valley of Ten Thousand Smokes was one of wonder and astonishment. I was astonished at the great dimensions of the valley and at the countless numbers of fumaroles and fissures out of which the steam issued, to say nothing of the many other gorgeous and magnificent displays of nature. Never in my wildest dreams had I imagined anything to compare with these.

"Greatest of all was my surprise that so much energy could be released in such an easy and quiet manner without apparent injury or danger to any one or anything. I experienced no sensation of fear while staying in the valley, perhaps because my mind was so filled with astonishment and admiration at this great marvel of nature, or because I was foolhardy and did not realize the grave dangers of falling into one of those hot places.

"I had no hatred of the place during my short stay there, although we were surrounded by many discomforts, and I said, soon after we left, that I would like to come back some time and see the place again. I am very proud to say that I was a member of the expedition which overcame the difficulties and hardships and first explored such a wonderful place."

THE COMPLAINT OF A TOPOGRAPHER

Clarence F. Maynard, Topographer.— "To me the Valley of Ten Thousand

Photograph by Robert F. Griggs

OUR WARMING OVEN IN THE VALLEY

We could keep our dinner hot by setting the pot in a hole, scooped out anywhere in the ground.

Smokes is a stretch of country that offers all the usual difficulties of topographic surveying in Alaska, with a few rather unusual ones thrown in for good measure. It is hardly a country to make the heart of a topographer glad.

"The smokes did not impress me with their grandeur or with their wonder as a natural phenomenon. Their ability to make surveying next to impossible did, however, make a very decided impression on me. On the occasional clear days when the sun was shining down the valley they seemed to be always at their best, as Griggs would put it, but to my mind at their worst. On these, the few rare days when it was not raining and the wind was not doing its best to move our camp (rather good judgment on the part of the wind, I should say) they would shoot forth jets of steam which soon took the form of clouds and obscured the country we were trying to work.

"I finally began to believe that the smokes were out to buck me, and became convinced of it when, on one of the rare fine days, I ascended to a peak which immediately became enveloped in fog. This was not unusual, but I was impressed on returning to camp to hear from the more fortunate members of the party that the whole valley had been clear with the exception of the peak I occupied.

"I am not a vegetarian; furthermore, tea cooked in a steam pit is not tea. A tent that never sheds a drop of water is not a tent. A wool comfort placed on the ground which was 110° Fahrenheit in the above tent will steam beautifully. It is a natural phenomenon, but it is not a good bed. I believe I mentioned that I am not a vegetarian. I like bacon in the morning; I like it fried. A steam jet, in spite of its being glorious and a natural phenomenon, will not do this. I am from New England and have decided ideas on baked beans. Again the steam jet fell down. It needs New England training. Steamed beans are beyond the limit of its capabilities.

"I should say the coming of the smokes ruined what might otherwise have been a perfectly good country. My opinion, however, is probably valueless, as being out of tobacco always colors my views."

THE MODERN INFERNO

James S. Hine, Zoölogist.—"A hike of miles over devastation wrought by natural disturbances in the Katmai country naturally puts one into a peculiar state of mind. He is deeply impressed with the enormity of the whole affair and everything seems beyond comprehension. The unusual circumstance of summer with no plant life and no animal life surely is a strange realization.

"Having reached the summit of Katmai Pass, the Valley of Ten Thousand Smokes spreads out before one with no part of the view obstructed. My first thought was: we have reached the modern inferno. I was horrified, and yet curiosity to see all at close range captivated me. Sure that I would sink beneath the earth's crust at almost every

Photograph by J. W. Shipley

COLLECTING GAS FOR ANALYSIS FROM A SMALL VENT AMIDST A MAZE OF FUMAROLES

"In laying out work in advance it sounds easy to poke a glass tube into a vent and pump the gas into a collector, but in the field all sorts of difficulties crop out which require great patience and resourcefulness to overcome. Moreover, a volcano is not an easy customer to deal with at close range."

step into a chasm intensely hot, I yet pushed on as soon as I found myself safely over a particularly dangerous-appearing area. I didn't like it, and yet I did.

"I felt like a boy at a circus, for I couldn't take time to study the attraction before me because I suspected something more captivating further on. Nor was I ever disappointed, for nothing was exactly like anything else.

"The broken hills, the falling mountains, the magnificent glaciers, the steaming fumaroles, and the rolling streams can all be described, but their wonderful profusion and the manner in which they encroached upon one another must remain largely in possession of him who is fortunate enough to make a visit to the locality where these things abound in extraordinary splendor."

LIKE A HUGE CHEMICAL MANUFACTURING PLANT

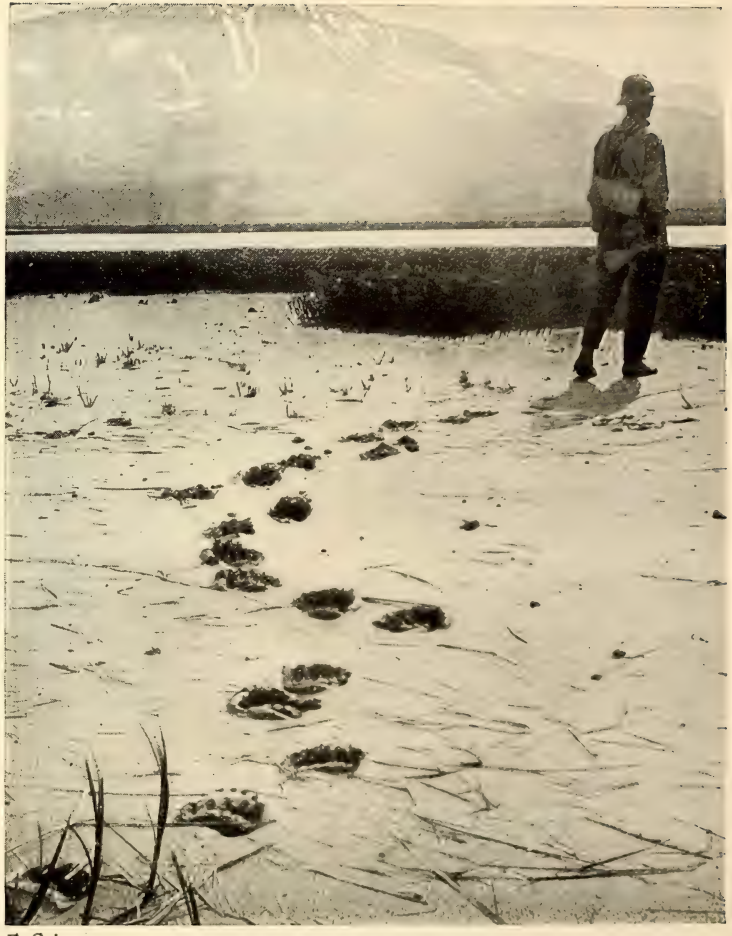
L. W. Shipley, Chemist.—"On first entering the valley from between the two guardian volcanic cones, I experienced the same sensation as the man who on seeing a giraffe for the first time exclaimed, 'There ain't no such animal.' The quiet evolution of myriads of columns of vapor from the floor of a wide, desolate valley, the encompassing mountain ridges, the sequestered isolation, the avalanches of rocks, all vividly recalled Sinbad's adventures in the 'Arabian Nights.' It is so unreal.

"Hot streams flow from beneath banks of snow; extensive glaciers hobnob with steaming fumaroles, while icebergs and hot water are found in the same little lake. Enormous mud-flows appear to have run uphill. A stick chars when

A BEAR TRAIL THAT SPROUTED

The fresh tracks in the soft mud caught the grass seed, which blew across the smooth general surface without finding any place of lodgment.

Photographs by Robert F. Griggs



IN THE PATH OF THE KODIAK BEAR

These are the huge tracks of an animal which followed the members of the expedition up the Katmai River valley. They are not the tracks of the bear which Professor Griggs mentions as having crossed the Valley of Ten Thousand Smokes, leaving steaming fumaroles in its wake (see page 129).

thrust into a jet of steam. It is uncannily unreal.

"But the unreality suddenly vanishes when one's foot breaks through the crust and hot volcanic gases rush out. It is also sufficiently realistic to have avalanches of rocks galloping down the 2,000-foot face of Falling Mountain while we are collecting gases in the bottom of a 20-foot hole at its base.

"The familiar fumes of hydrogen sulphide, sulphur dioxide, and hydrochloric acid transform the valley into a huge chemical manufacturing plant roofed over by a permanent cloud of vapors. And when cold and wet, it is rather comfortably lonesome to lean against the hot walls of a sheltered crevice and meditate on the dead bodies of hundreds of flies lying around the orifice of the subterranean chimneys."

A SPECTACLE OF AWESOME MAGNITUDE

D. B. Church, Photographer.—"Regardless of our packs, we hurried down the valley, past the few faint, wispy steam jets that mounted from its floor just over the divide, craning to glimpse the first steam cloud to rise from the valley beyond. There floated over the spur of the ridge to the north a billowy cloud that marked the largest steamer.

"Reaching the higher ground that had hidden my view, I gazed at the panorama before me. Flanked by Mt. Cerberus and Falling Mountain, spread the valley, a maze of pearly columns that billowed skyward and bent before the strong westerly wind. Down a narrow canyon we trudged and climbed out over its painted ash walls onto the valley floor.

"The meager pictures of the previous year, and even the graphic descriptions of Griggs and Folsom, had not prepared me to face such a spectacle of awesome magnitude. I had pictured the valley as large; the actual view dwarfed my wildest imagery to insignificance.

"I started for the nearest fumarole; it seemed a few hundred yards distant. I found it half a mile away. It was a small fumarole and I crept cautiously up to its edge. From its red-painted throat, which vanished deep in blackness, the sulphur-reeking steam roared forth in a smothering blast.

"Passing back, I found a crack in the rock-like crust of the mud-flow, through which sizzled the scorching steam and gas. A few prods with my staff opened a hole into the underground conduit, from which the steam hissed forth. The fragility of the crust and knowledge of the result of a misstep startled me. My fears began to awaken—fears that for several days made me tiptoe over spots where the earth rang hollow beneath my feet. Familiarity gave me greater confidence, but I never ceased to tread carefully the color-daubed regions of subsurface activity.

WORK DROVE AWAY FEAR

"The next day I began my work in the valley. This day the activity and the interest of work drove fear from me. The one conception that pervaded me was: how like this place to Dante's conception of his 'Infe no.' It seemed to me, as we stood on the edge of Novarupta, that this was the Devil's own private corner in hell itself. It seemed, as I gazed at the seething steam clouds that rushed from the cooling lava plug, and at the shattered, steam-smothered furnace that filled the rising vale beyond, that there was some vague, fantastic form, a horrid dream, a hideous, potent 'thing' which was not for human eyes to see nor human ears to hear.

"Then an endless night on the hot, moisture-teeming ground; an endless rolling from side to side to escape the torment of the penetrating heat that seeped up from the hot, sodden ground; and always, as I looked down the valley through the open tent door, shone the marble-like steam columns, which, like tall, writhing specters, swayed in the dim twilight.

"There was always a certain awesomeness about the valley which clung to me throughout my stay. I looked forward with relief to the time when I could put from my sight the curling steamy billows that rose from fumaroles and mounted ever skyward.

"Pictures cannot bring back the Valley of the Smokes. They have lost the awesomeness that lies in the setting. You may build in memory, but never reproduce, the scenes which lie beyond the

Photograph by Robert F. Griggs

TAKING THE TEMPERATURE OF A "HOT ONE"

Most of the vents were so hot as to be beyond the range of our thermometers; so hot that the steam would char a piece of wood and did not begin to condense for some distance from the orifice.

Katmai Pass. They seem too big to be a part of the rest of the world. They do not seem to connect up with the little things which are built into our lives.

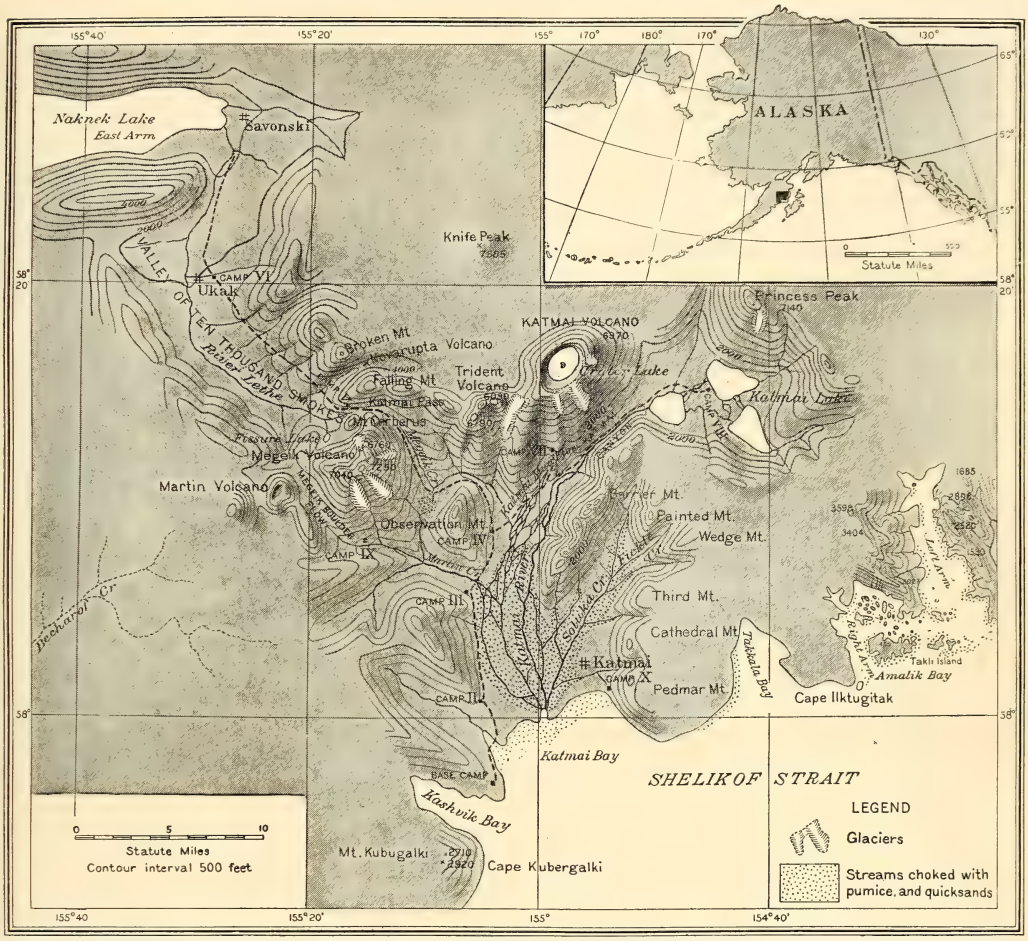
"Outstanding in my memory is the valley as I left it. It was a brilliant day, with puffy silver clouds that floated on a sky of deepest blue and sunlight that glinted on opalescent steam jets and sparkled on peaks fresh-capped with snow.

"As, homeward bound, we skirted Cerberus, the steamers turned in the dying sunlight to shimmering gold and the snowy crests of distant mountains glinted yellow. I forgot the heavy pack which bowed my shoulders as I glanced backward at the growing beauty which filled the valley. Through its giant gateway the 'Valley of the Ten Thousand Smokes' sank from sight as we dropped over the pass, and the sky above reddened to a crimson halo in the fading rays of the sinking sun."

PERSONNEL OF THE EXPEDITION

The organization of the expedition, perfecting details of equipment and supplies, and seeing that they were on the ground when needed, had consumed a large share of the Director's time and energy for more than six months before the departure from Seattle; but the result justified the labor, for the outfit proved adequate to the strain put upon it and enabled us to carry out the work substantially as planned.

There were three problems to be met: First, to secure men who could stand up under the excessive physical labor involved and continue to do the scientific work contemplated, each in his own line; second, so to provision and maintain the expedition as to retain its efficiency until



OUTLINE MAP OF THE VALLEY OF TEN THOUSAND SMOKES

its work should be complete; third, to transport the outfit to the scene of action.

The success with which the first of these problems was overcome is perhaps best attested by the fact that the chief concern of the Director in the field was to hold down the men and prevent them from working so hard as to wear themselves out. There were ten of us, as follows: Robert F. Griggs, Director; Lucius G. Folsom, Assistant to the Director; Clarence F. Maynard, Topographer; James S. Hine, Zoölogist; J. W. Shipley, Chemist; Donovan B. Church, Photographer; Jasper D. Sayre, Assistant Botanist; Paul Hagelbarger, Assistant Botanist; Walter Matroken, Packer; Andrean Yagashoff, Packer.

Without exception, these men worked, each in his own way, to the full extent of his ability for the success of the expedition. The energy, enthusiasm, and self-sacrificing service given to the work were unlimited. The way in which they took hold of tasks, which were always laborious, often very disagreeable, and had usually to be done against obstacles that would have turned back any but the most persevering, proved their worth and won the enduring gratitude of the Director.

ONLY THE MOST CONCENTRATED FOODS COULD BE USED

Previous experience with the conditions around Mt. Katmai made the provisioning of the expedition less difficult.

The limitations of transportation prohibited the use of any of the ordinary canned food, or any food containing water, except at the base camp. Our

Photograph by D. B. Church

MEMBERS OF THE NATIONAL GEOGRAPHIC SOCIETY'S ALASKAN EXPEDITION AT KODIAK, AFTER HAVING COMPLETED THEIR WORK IN THE VALLEY OF TEN THOUSAND SMOKES AND ON MT. KATMAI

From left to right: Jasper D. Sayre, Botanist; Clarence F. Maynard, Topographer (Mr. Maynard was the Topographer of the National Geographic Society Peruvian Expedition of 1915); D. B. Church, Photographer; Lucius G. Folsom, Assistant to the Director; Robert F. Griggs (Chief of Expedition), Botanist; James S. Hine, Zoölogist; J. W. Shipley, Chemist (Mr. Shipley was granted a leave of absence from the Manitoba Agricultural College to accompany the expedition); Paul R. Hagelbarger, Botanist; Andrean Yagashoff, Packer, and Walter Matroken, Packer.

chief reliance was the trusted stand-by of the prospector, bacon and flapjacks. Next came rice, oatmeal, beans, tea, coffee powder, dried apples, apricots, and dehydrated fruits, such as cranberries, raspberries, and strawberries. Lunch consisted of pilot bread, cheese, raisins, kippered salmon, and milk chocolate, for we stopped to cook only morning and night.

As an experiment, I included tinned butter among our supplies. This proved a boon, for it added greatly to the enjoyment of flapjacks and served as a very fair substitute for condensed milk on oatmeal, etc. We could hardly have got along without it in the Valley of Ten Thousand Smokes, where we could fry no bacon. A reflecting oven enabled us to bake bread and biscuits at the lower camps. These proved very welcome, as experience has shown that the lack of bread and butter is a deficiency in the diet so serious as to become almost intolerable after a time.

These provisions proved very satisfactory. All members of the party were in perfect condition throughout the summer. Several of us gained in weight, and one of the boys was 20 pounds heavier than he had ever been before, despite the fact that he had rather more than the average of hard work. On the return there was almost none of that insatiable craving for a change of diet which is apt to develop after a few weeks' use of concentrated rations.

Photograph by D. B. Church

FORDING THE CREEK UNDER THE SHADOW OF MT. MAGEIK

The waters of this stream were swift, but shallow, and presented no dangers in crossing, fears of quicksand proving ungrounded. All supplies for the stay in this valley had to be man-packed from base camp, and obstructions like this creek presented many difficulties for the heavily laden members of the expedition, even though the element of personal peril was not always present.

CARRYING IN SUPPLIES ON MAN BACK

The problem of transportation was in a way the crux of the whole situation, for everything else depended on its solution. We considered pack-horses, but the difficulty of landing them through the surf, of providing fodder in the devastated district, and of managing them in quicksands and bad lands made them seem impracticable. We therefore fell back on the most primitive of all means of transportation — man - back packing. Every member of the expedition understood from the start that he was to be pack-animal first and scientist second, and all stood up under the strain of labor, to which several of them were quite unaccustomed.

The plan of operation was to proceed half a day's march from camp, establish a new camp at the terminus, from which two men explored the country round about, while the others brought up supplies, returning each night to the starting point till a sufficient quantity had been accumulated to permit another move forward. By thus moving short distances the packers were able to dispense with all duffle, carrying freight exclusively, and the heaviest consumption of food was kept behind the front.

Perhaps the best way to convey an impression of the labor involved in such procedure will be to state the cost. We found that by the time a 50-pound sack of flour had been carried into the Valley of Ten Thousand Smokes it had cost us $17.50.

LANDING THROUGH THE SURF

In previous years we had landed near Katmai village, on the north side of the

Photograph by D. B. Church

THE TRAIL UP TO KATMAI PASS

The way led over permanent snow-drifts, for the snow had been covered with ash during the eruption of Mt. Katmai, and this coating protects the drifts from the sun's rays. All the supplies for the camp had to be carried laboriously on the backs of the men through this pass into the valley.

bay, taking the shortest route to the volcano. But in 1917 we landed on the south side, near Kashvik Bay. Here we found a beach which, while apparently exposed to the storms, was in reality so protected by an offshore reef as to be much safer than Katmai beach, affording the best landing for many miles along the coast. Even as it was, however, one of the dories carrying our stuff to the ship on the return was nearly swamped, so that our outfit was considerably damaged by salt water.

FIRST SIGHT OF MT. KATMAI

By landing to the south of Katmai Bay, we had the added advantage of being able to place our base camp in a district unaffected by the eruption, for this area lay to one side of the great ash cloud which was carried to Kodiak on the west wind. This fact enabled us to carry on important biological studies in the comparison of devastated with undevastated country, which our situation had precluded on the previous expeditions.

Our first sight of Mt. Katmai came the day after we landed. Familiar as I was with the volcano from the work of the two previous seasons, its enormous size struck me as a new surprise. Here from a distance of over 20 miles the mountain loomed up so much bigger than the nearer mountains as to dwarf them. The great jagged edges impressed us all with a new conception of the immensity of the crater within.

Some of the new members of the expedition, seeing the volcano for the first time, accused me of not having given a correct impression of it in the article of 1917. They had not expected anything nearly so big. As I looked at it, standing three or four times higher than the clouds which drifted up the valley, I could not restrain a feeling of pride that

A CONICAL ROCK PILE ON THE SURFACE OF THE MAGEIK BOULDER FLOW

Photographs by D. B. Church

ONE OF THE LARGE ROCKS CARRIED DOWN IN THE MAGEIK BOULDER FLOW

This phenomenon resembled a great landslide. Coming down the mountain, the mass of rock and soil made a right-angle turn into the valley like a stream of water (see page 161)

Photograph by J. W. Shipley

ENJOYING A FLAPJACK FEAST IN CAMP AT THE BASE OF MT. KATMAI

Flapjacks were a treat to the members of the expedition, for during their stay in the Valley of Ten Thousand Smokes griddle and frying-pan cookery was impossible, owing to the absence of wood. Here cottonwood trees were plentiful, but it was a ghostly forest, as all vegetation was killed by the shower of ashes which fell when Mt. Katmai exploded and erupted six years ago.

I had actually stood on the rim of that tremendous pit and looked down into the caldron below.

The first camp established up the valley was at the mouth of Martin Creek. From this base a party was sent to explore Martin Valley and Martin Volcano. [This interesting volcano was discovered by the 1915 expedition of the National Geographic Society, see pages 33 and 34, NATIONAL GEOGRAPHIC MAGAZINE, January, 1917.]

We were disappointed in our expectation of examining the crater of Mt. Martin because of the weather. We waited for several days, both on the way up the valley and on the return trip, but without success. At the beginning of the season it was left till later, and on the way out a week was reserved for exploration; but this proved insufficient, for the clouds never lifted until several days after we had had to pack up and come away without having so much as attempted the climb, because of the approach of the time for the boat to come and take us back to civilization. As the event proved, we would have had to wait fully ten days before the climb would have been possible. Only once while we waited did we have so much as a sight of Mt. Martin. One morning the clouds lifted for about an hour, so that we were able to secure some long-range pictures, but before we were ready to try the ascent they had closed down again and we had to abandon the attempt.

But, though disappointed in our hopes of exploring this volcano, we found in another feature abundant reward for the time spent in the vicinity.

ANOTHER CONVULSION OF NATURE

For at the head of Martin Creek is one of the most interesting phenomena of the whole volcanic district—what, for want of a better term, I have called the "Great Mageik Boulder Flow"—a third wonder, almost worthy to be ranked along with the crater of Katmai and the Valley of Ten Thousand Smokes. When I say that a mass of rock and soil containing boulders as big as a house flowed like water down a valley, I shall probably be classed with Münchausen, the prince of liars; but, fortunately, these are the days of the camera and I can prove my assertion.

During the eruption, quite possibly coincident with the bursting forth of Martin and Mageik volcanoes, the whole face of a mountain let go and flowed down into the valley, carrying destruction to everything within its reach. It was a real example of one of those great and sudden "convulsions of nature" of which one reads so much in the older literature, but of which he sees so little evidence in the world about him; for even in a volcanic district most phenomena clearly belong to the regular order of nature.

But here, for once, is a formation so remarkable as to make it appear at first sight that the ordinary laws of nature were suspended during its formation.

Rocks, exceeding ten feet in diameter, are abundant in the flow, which in some places is made up almost entirely of such big boulders without any mixture of finer materials. Much larger rocks are by no means uncommon. We found many reaching 30 or 40 feet in length. The largest single stone we observed was about 50 feet long, 20 feet wide, and 20 feet high, lying largely concealed in the mass of detritus (see page 159).

It seems incredible that a body composed so largely of angular rocks could by any means have acquired such a high degree of fluidity as is shown by this mass, but in view of the fact that it turned a corner in the valley and adjusted itself to the irregularities of its bed, one is compelled, in justice to the facts, to recognize that its motion was more of a flow than a slide.

Nowhere can one form a reliable estimate of its thickness, but over much of the ground it must exceed 100 feet. The total mass of materials moved was therefore stupendous.

At the extremity it is composed mostly of chunks of the old peat soil, which originally covered the mountain side with only small quantities of rock fragments. Boulders are more numerous a little back from the tip, and in places the terrain is composed exclusively of broken stone over considerable areas.

One of the most curious features is the character of the surface, which lacks entirely the hummocky appearance typ-

ical of the ordinary landslides, but instead is covered in many places by regular, steep-sided, conical piles of material. Some of these stand isolated; others are thickly grouped. Since their slopes stand at the "angle of repose," it is probable that they were formed by the shaking down of more irregular masses (see page 159).

THE ASCENT OF KATMAI

After the successful ascents of 1916, we considered the climbing of Katmai itself a secondary matter. The main object in making the climb on the 1917 expedition was to survey the crater, ascertain its dimensions, and to secure better pictures of the abyss. Remembering our previous difficulties with soft, slippery mud, we decided to leave the ascent until late in the season, after the winter's snow had melted and the mud had had time to dry up somewhat.

Days for climbing the high mountains were very few in 1917, and we had to wait in idleness for a full week before there came any chance to try. Even then we were cheated, for the clouds began to gather as we ascended and completely shut down just as we reached the crest. We had one fleeting glimpse of the crater, but before we could so much as set up a camera it was gone, and we had to wait three days more before there was another chance to make the climb.

Our decision to defer the ascent till late in the season was well founded, for in places where the year before we had floundered up the slopes in slippery mud ankle deep we found the ground hard and firm, so that the climb, which before had taxed our strength and endurance to the very utmost, was now made easily in four hours, even under 30-pound packs. Those who had not gone through the previous experience had difficulty in believing that the climb could have been so much harder until we came upon our old trail, broken so deeply into the mud that it persisted sharp and clear for a long way, so that every one could see for himself how he was traveling easily over firm ground, where before we had plowed along ankle deep in mud.

This was only one of the many frequent examples we had of the difference between doing a thing for the first time and following along after the path is broken. I have no doubt that some day our accounts of the difficulties we encountered with the limited facilities at our command will appear incredible to those who may tour the district provided with all the facilities and comforts of modern travel. It seems to me entirely practicable, for example, for any one to ride up to the very rim of the crater astride a horse. All that is needed is the organization necessary to furnish the horse and the fodder.

AN ABYSS OF INCONCEIVABLE SIZE

In spite of the disappointment on the first attempt, every one of the party was enthusiastic over the crater, and all agreed that the single glimpse we had before the clouds shut in was ample reward for the climb. Some members of the party indeed thought the sight more beautiful and wonderful than the Valley of Ten Thousand Smokes itself. The party were unanimous in the opinion that the photographs convey no idea whatever of the vast abyss. Without the colors and with nothing to indicate the scale, to give more than a hint of the real character of the phenomenon is impossible. Like the Grand Canyon and other sublime marvels of nature, the crater must be seen to be appreciated.

But even when one stands on the rim and looks down, he can gain no conception of the real magnitude of the crater. It is so far beyond any one's powers of perception that the wonder comes back to him and grows with each visit.

I found myself surprised at the crater's grandeur, in spite of my experience of the previous year, for it was far more sublime than I had remembered it. One reason why the magnitude of this volcano is so hard to grasp is that the proportions are so perfect that no one dimension appears exaggerated at the expense of the rest. If the crater were not so deep, the area would be more evident; if the walls were not so precipitous, one could better measure with his eye the distance to the bottom. But as it is, one can only realize that the immensity of the awesome abyss is far beyond the grasp of his mind.

Photograph by D. B. Church

CLIMBING OUT OF KATMAI CANYON

The wall opposite is as high as parts of the Grand Canyon, as beautifully colored, and as precipitous (about 4,500 feet). This is one of the many natural wonders of surpassing grandeur in the Katmai volcanic region which have been made known to the world through the explorations and discoveries of the four National Geographic Society expeditions.

Photograph by D. B. Church

THE ONLY HOOKS USED IN CATCHING THESE SALMON WERE HANDS

In a small creek which runs into Katmai Valley the members of the expedition found these four and five pound fish which had come up into fresh water to spawn. They were easily caught by the tail in the shallow pools.

Photograph by J. W. Shipley

CARRYING GRASS FIVE MILES INTO THE DESERT FOR THE SAKE OF AN EASIER BED

Some of the members of the expedition had not the foresight to provide such mattresses; their blankets, therefore, were spread upon pebbles. This was Camp Four, the last camp before entering the Valley of Ten Thousand Smokes (see map, page 155).

Photograph by J. W. Shipley

WORK OF THE GREAT FLOOD IN THE KATMAI VALLEY

A stream flowing between Katmai Volcano and its neighbor had piled up an immense dam across the valley. Behind the dam a vast lake accumulated. Then the dam burst and the torrent, like a Johnstown flood, rushed seaward. For miles, where thick forests had stood, the trees were sheared off at the surface of the ash. The few trees which remained were bent, twisted, splintered, and broken in every describable manner (see the story of this flood in the January, 1917, GEOGRAPHIC).

Photograph by D. B. Church

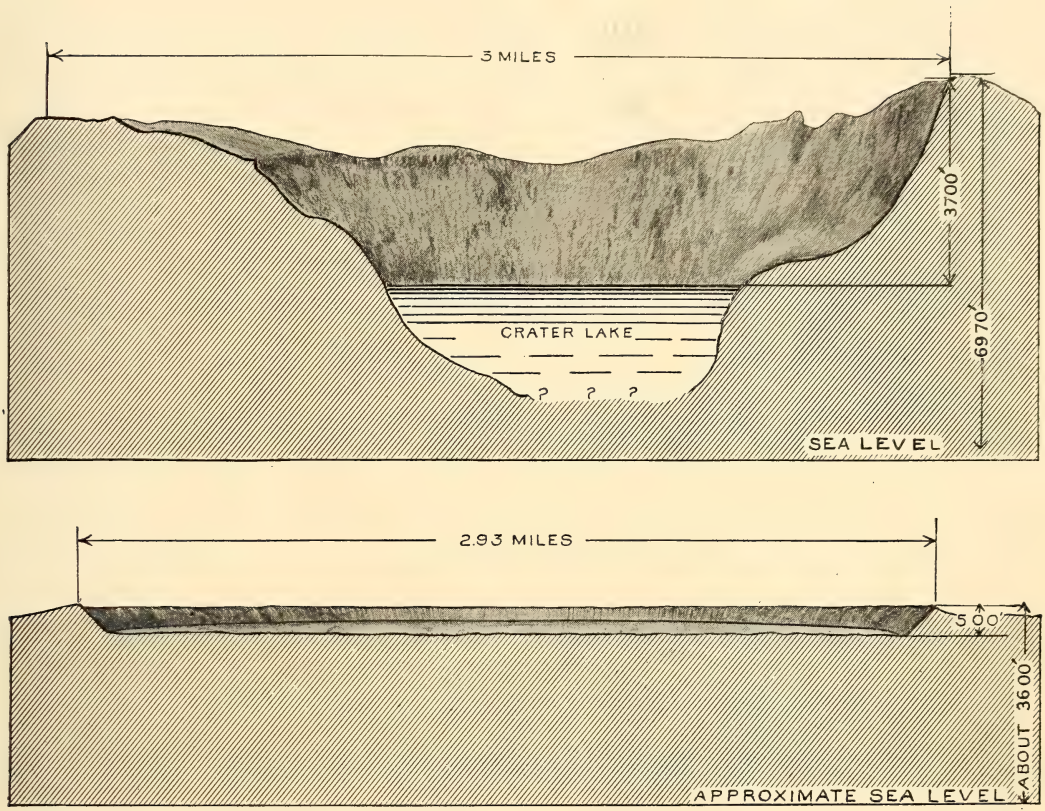
A CHEMICAL LABORATORY IN THE KATMAI REGION

Only a chemist can understand the difficulties of making quantitative analyses where one must carry his laboratory on his back

Photograph by Robert F. Griggs

MT. KATMAI, TITAN OF VOLCANOES: ALASKA

The eruption of Mt. Katmai, in June, 1912, was one of the most tremendous volcanic explosions ever recorded. A mass of ash and pumice whose volume has been estimated at nearly five cubic miles was thrown into the air. This left Katmai as it is shown here, the mere stump of its former self; the white line indicates approximately the original height of the mountain. The great arc shown in the photograph is the rim of the gigantic crater within. The peaceful steam clouds now floating up from the crater, compared with the devastating blast which completely disemboweled the mountain, are like the wisps of smoke which come from the cannon's mouth after the projectile has been fired.



THE KATMAI CRATER (UPPER) COMPARED TO KILAUEA CRATER (LOWER)

Until the National Geographic Society explorations, Kilauea of Hawaii had been considered the greatest active crater on earth, but it is now proven to be far exceeded in size by the world's youngest of volcanic vents, the Katmai crater, which is not yet six years old (see page 168).

Knowing that the size of the volcano was beyond my powers of comprehension, and having no means of ascertaining the dimensions, I did not dare in 1916 to report my real judgment of its depth, for fear that in the excitement of the moment I should have made some wild exaggeration that would put me in an embarrassing position when the actual dimensions were obtained. The facts prove that even our largest estimate of depth was far short of the truth!

I dared not then make any comparisons with the other great craters of the world; but now, with the data of Maynard's accurate survey at hand, such a comparison furnishes the best means of conveying an impression of the magnitude of Katmai itself.

DIMENSIONS OF THE CRATER

The survey shows that the width of the crater rim, as seen from below, which includes all of the concavity on top of the mountain, is 3 miles. The circumference, measured along the highest point of the rim, is 8.4 miles. The area is 4.6 square miles. The precipitous abyss, which does not extend to the rim on the southwest side, is somewhat shorter, measuring 2.6 miles in length, 7.6 miles in circumference, and 4.2 square miles in area. The milky blue lake in the bottom is 1.4 miles long and nine-tenths of a mile wide, with an area of 1.1 square miles. The little crescent-shaped island in the lake measures 400 feet from point to point. The precipice from the lake to the highest point of the rim is 3,700 feet.

Photograph by Clarence F. Maynard

KATMAI, THE GREATEST ACTIVE VOLCANO IN THE WORLD

If every skyscraper, department store, tenement-house, theater, and residence—every structure reared by man—in Greater New York were dumped into the Katmai crater, there would still be a yawning abyss twice the size of Kilauea, in the Hawaiian Islands, until now considered the greatest active volcano in the world.

The cubical capacity of this stupendous hole is no less than 4,500,000,000 cubic yards. Into the crater 900,000,000,000 gallons could be poured. This is more than four times the total capacity of the Ashokan and Kensico reservoirs, from which Greater New York now receives most of its water, and the Schoharie reservoir, which is to be constructed. New York City uses 550,000,000 gallons of water daily. Katmai crater once filled could supply the American metropolis for 1,635 days.

But even these figures do not tell the whole story, for they do not include the amount of rock that was blown off from the mountain during the brief sixty hours of its explosive activity. There must be added the material in the peak above the level of the present crater rim.

The figure then arrived at is 11,000,000,000 cubic yards. This is over forty times the amount of earth and rock removed in the construction of the Panama Canal.

KATMAI, THE GREATEST ACTIVE CRATER IN THE WORLD

Kilauea, in the Hawaiian Islands, has always been accounted the greatest active crater in the world, but it is clear that it must now yield the palm to Katmai. Kilauea's greatest diameter is 2.93 miles, its circumference is 7.85 miles, and its area is 4¼ square miles. These dimensions are slightly smaller than the corresponding ones on Katmai. The great difference is in depth, Kilauea's greatest depth being 500 feet, while Katmai's is 3,700 feet.

Of craters no longer active, only two surpass Katmai in dimensions: Crater Lake, in Oregon, measures 4 miles wide by 6 long, while Haleakala, in Hawaii, has an area of 19 square miles. But while Katmai is somewhat inferior to these in size, yet because of its proportions it is a far grander spectacle to look upon; for in both Haleakala and Crater Lake the cliffs surrounding the pit

are so much lower comparatively as to make their craters inferior to Katmai, from a scenic point of view. The tremendous depth more than any other feature impresses the beholder of Katmai.

Moreover, if one recalls the fact that the beautiful blue of the Katmai lakes and the wonderful canyon of Katmai River, which is almost as deep as the Grand Canyon, lie in full view from the crater rim, he will recognize that for sublimity of scenery this place has no equal in the whole world.

ALL OF THE BUILDINGS OF GREATER NEW YORK WOULD NOT FILL THE CRATER

Statistical comparisons of objects, so far from the experience of most people, can give, however, no conception of their real magnitude. Our comparisons must be with objects and places within our every-day experience. As I sought for some familiar object big enough to serve as a basis of comparison with a hole of such enormous dimensions, I remembered the experience of my first attempt to see New York City afoot. I can never forget my bewilderment at the endless rows of closely built blocks, series on series, and how I found myself physically exhausted long before I had begun so much as to inspect the city in detail.

Here, then, is an almost inexhaustible supply of objects, large enough to serve as units for the measurement of cubic capacity of almost unlimited dimensions. If one could pick up the blocks of buildings of New York one by one and drop them into the crater of Katmai, how many would be required to fill it?

The truth is that if a typical New York tenement block should be set bodily into the crater of Katmai it would be but a drop in the bucket. But the tenement houses are relatively insignificant in comparison with the skyscrapers of lower New York. How would they appear in the crater? One must answer that it is doubtful whether all of the skyscrapers of New York together would fill the lake at the bottom of the abyss.

Photograph by Paul R. Hagelbarger

OUR FLAG, WHICH FLEW ALL SUMMER FROM THE LOOKOUT AT BASE CAMP, BY THE SEA

If one could imagine himself really trying to fill the crater with the buildings of New York he would find that if he dropped them in, block by block, the task would be so long that he would soon want to begin operations on a larger scale, cutting off bigger and bigger slices of the city, as he worked up town.

Even so, he would be astonished at the capacity of the hole, for after he had made a clean sweep of Manhattan Island he would find that he had only begun on his job! He would have to cross the river and continue through Brooklyn, then take the Bronx, and all the other boroughs of Greater New York. And if every single structure erected by man in this great city were deposited in the crater they would by no means fill the vast abyss. On the contrary, the hole that remained would still be a good deal more than twice as large as Kilauea!

NATIONAL GEOGRAPHIC SOCIETY

SINCE ITS FOUNDATION, thirty years ago, the National Geographic Society has been responsible for many notable achievements in the realms of discovery, exploration, and conservation.

Its Peruvian expeditions resulted in the discovery by Hiram Bingham of the Lost City of the Incas, Machu Picchu, the great capital which was the seat of power and culture of a remarkable civilization that flourished in the Western Hemisphere for centuries before the coming of Columbus.

It assisted in financing the expedition of Rear Admiral Robert E. Peary, which discovered the North Pole.

Its contribution of $20,000 saved from destruction a wondrous forest of giant sequoias in California, and gave it to the American people as a part of our national-park system.

Now come the discovery of the Valley of Ten Thousand Smokes and the survey of Katmai, the world's greatest active volcano—achievements which will rank with the foremost contributions to world geography in modern times.

Each of the 650,000 members of the Society will experience a feeling of pride and satisfaction in this latest accomplishment, for it was their financial support of the organization's aims, "the increase and diffusion of geographic knowledge," that made possible the equipment of Robert F. Griggs and his intrepid associates for the task which they have performed with signal distinction and success.

HELPING TO SOLVE OUR ALLIES' FOOD PROBLEM

America Calls for a Million Young Soldiers of the Commissary to Volunteer for Service in 1918

By Ralph Graves

MRS. MULVANY with her pet pig is no longer an object of ridicule and a topic for jest. She is a patriot. The Solomons of conservation are sending Mr. Average Consumer to her as a model of thrift, just as the Wise Man of Biblical times sent the sluggard to the ant. By means of her pig Mrs. Mulvany is helping to win the war, for she is making from one to two pounds of pork grow each day where none grew yesterday.

"Go thou and do likewise" is the plea of the officials of the U. S. Department of Agriculture, upon whose shoulders rests the burden of educating the American public to the necessity for the production of millions of pounds of additional food-stuffs in order that the armies of liberty—American, French, British, and Italian—may be kept efficient on the battle-front and in the training camp.

Mr. Mulvany calls Mrs. Mulvany's pet "the gintleman that pays the rint," while throughout the Middle West, since the pioneer days, the porker has been known as the "mortgage-lifter." For the last eight years the pig has occupied an increasingly important place, both in the economy of the farm and of the village household, and has been a stimulus to the productive activities of thousands of boys who have organized "pig clubs."

The members of these and related agricultural clubs have recently received a new designation of tremendous significance—soldiers of the commissary. There were 45,000 such soldiers in the pig divi-

sion of the commissary army in 1917—an army whose total strength (corn clubs, potato clubs, poultry clubs, sheep clubs, calf clubs, and canning clubs) was well over half a million.

This year an army of one million is needed. It must be a volunteer, not a conscript, army, and the age limit is from 10 to 18 years. Recruits will not be confined to the farm districts; enlistments are equally desirable from towns, villages, and the suburbs of our great cities.

What has been accomplished by America's youthful commissary army is a story of surprising and stimulating interest, an incentive to redoubled effort during the next nine months, when every ounce of meat produced, every bushel of grain, every can of vegetables, every pound of wool, will have a direct and potent bearing upon the length and conduct of the war.

POPULAR PREJUDICE WITHOUT FOUNDATION

Just as the aviation service, more than any other branch of the army or navy, exercises an irresistible appeal to young Americans eager to join the fighting forces of the United States, so the pig clubs are exercising a peculiarly strong appeal to the boys and girls of the country. The result will not be transitory and for the immediate necessities only. In fact, the direct and indirect effects of the pig-club movement throughout the South, where it originated less than eight years ago, have been so salutary that the United States Government, even before the emergencies brought about by the war, inaugurated a widespread campaign to encourage and promote the extension of the work.

One of the first and most essential steps to be taken in the effort to increase the number of pig fanciers and enthusiasts is a campaign of education to disabuse the public mind as to the habits and nature of pigs. Few domestic animals have been so persistently maligned and with so little reason.

Instead of being the unclean, insanitary creature almost universally depicted, it is the testimony of those who know the pig best that it is one of the cleanliest of animals, surpassing the dog in this respect. It is true that many towns have ordinances which prohibit the keeping of pigs within their corporate limits, but these restrictions have been the outgrowth of the carelessness and negligence with which pigsties have been tended in the past. When given the same care which customarily is observed in keeping the stalls of horses and cows in proper condition, pigsties are far more sanitary and less odoriferous. A pig, given a bed of straw, will keep it clean, in striking contrast to the habits of horses and cows in stalls.

Those who appreciate the value and importance of the "keep a pig" movement and are anxious to foster the substitution of pigs for dogs as pets have begun campaigns in many communities to procure a modification of town ordinances which will permit the raising of a pig or pigs on premises where careful sanitary regulations are strictly observed.

There are more than 10,000,000 boys and girls in the United States between the ages of 10 and 18 years. It is an extremely reasonable ambition on the part of the Department of Agriculture to enlist one-tenth of this number into active service as food-producers, supplementing and coöperating with the farmers and the housewives in their essential labor of increasing the supplies so vitally needed in the present emergency.

THE BEGINNING OF PIG CLUBS

It was in the fall of 1910, in Caddo Parish, Louisiana, that a rural schools superintendent, E. W. Jones, originated and organized the first boys' pig club. It was a modest beginning, with 59 boys, who were in a quandary as to the best method of disposing of the crops which they had harvested in their corn-club activities. The pioneer pig-club promoter conceived the idea of affording the boys an opportunity of realizing a profit not only on their corn crops, but a feeder's profit on the grain as well.

When this movement began a pure-bred pig was a rarity in the South. The "razor-back," shifting for itself in the pine barrens and leading a "root-hog-or-die" existence while ranging over exten-

Photograph from Department of Agriculture

GROOMING A PIG FOR THE STATE FAIR

Eight years ago, before the inauguration of the pig-club movement in the South, most of the hogs in that section of the United States were of the razor-back variety—the kind which is so thin and scrawny that a wag has declared the farmer can prevent its going through a hole in his fence by tying a knot in its tail.

sive palmetto shrub tracts, was the only type of pig familiar to the farmer. Today blooded swine are the rule rather than the exception, and it is a high tribute to the educational value of the boys' pig clubs that of the four States—Mississippi, Georgia, Virginia, and Delaware—reporting an increase in swine population on September 1, 1917, over the same date in 1916, Mississippi and Georgia stand second and third in pig-club enrollment. These two States reported an increase of 90,000 hogs, while the country at large showed a decrease of 5,000,000.

One of the strongly emphasized slogans of the pig-club organizers and supervisors is that it does not pay to raise a poor hog. On the other hand, the profits to be derived from pure-bred pigs are exceptionally large, considering the amount of capital invested. This preachment not only has had its immediate effect in pig-club communities, where example has taken the place of precept, but it is causing the farmer to awaken to the fact that his son and his daughter are proving more efficient than he, simply because they are taking advantage of the information which has been gained by experts and specialists through years of experimentation and research.

THE "PRACTICAL" FARMER *vs.* THE PIG-CLUB MEMBER

The "theorists," as the college-trained agriculturists were once called, are no longer scorned by the "practical" farmer, whose "practicality" is seen in a very unenviable light when he is compelled to admit that it takes two years for his range-reared hog to acquire a weight of 150 pounds, while a pig-club member, like young Walter Whitman, of Indiana, presents as an exhibit his pet Duroc,

Photograph from C. C. French

BEING BROUGHT UP ON THE BOTTLE

A foundling of the sty finds a solicitous guardian in this member of a Texas pig club. The hungry little wee-wee will reward its master by proving a most interesting and harmless pet, and when it has outgrown its playful ways it will enrich the family larder and the boy's purse.

which gained 18 pounds, 21 pounds, 27 pounds, and 24 pounds in four consecutive weeks.

When Walter's pig was six months and seven days old it weighed 297 pounds, and on its eighth-month birthday it tipped the scales at 456 pounds. The average daily gain was 2.35 pounds, at a cost of nine and one-tenth cents a pound. George Barker, of Yeddo, Indiana, has a record of a daily gain of 2.24 pounds for his pig, at a cost of seven and three-tenths cents a pound, while the pig of Samuel Evans, Brazil, Indiana, gained two pounds a day during the feeding period, at a cost of six and two-tenths cents a pound.

In the Southern States, where pasturage is more abundant and dependence upon corn for fattening food is not so great, the cost of gain per pound is less.

ASTRIDE TWO HUNDRED POUNDS OF SEVEN-MONTHS'-OLD PIG

One of the by-products of the boys' and girls' club movement throughout the United States is the instilling of a love of animals, which will result in young people taking a greater interest in farm life.

BANKERS FINANCE PIG-CLUB BOYS

One of the most interesting developments of the pig-club movement has been the establishment of cordial business relations between bankers and boys who want to raise pigs. There are bankers in practically every State who are glad to supply club members with the necessary funds for their start as pork-producers. The State of Arkansas furnishes a typical example. Last year the bankers of that Commonwealth financed 2,400 boys and girls out of the total pig-club membership of 2,700.

Not only have such loans proved to be "gilt-edged" from the financier's standpoint, but they have been a direct source of increased revenue and business for the bank. A Texas banker recently bought 326 pigs for club members in his county and was able to trace $75,000 direct increase in his deposits as a result of the cordial relations established with the successful club members and their families.

In financing pig clubs the bankers cooperate with the joint representative of the State agricultural college and the U. S. Department of Agriculture, known as the State extension leader, who designates a pig-club agent to organize a county club. All of the efforts of the members are, therefore, under the supervision of a trained leader and practical teacher.

Two methods of financing have proved popular. The usual practice is to lend a club member the sum necessary for the purchase of his pig, the only security given the bank being the member's promissory note, bearing a nominal rate of interest. The note is paid when the pig is sold or, in case of a sow-and-litter project, when the weaned pigs are marketed.

The second method is known as the "endless-chain contract." Under this plan the bank distributes a number of weanling gilts among the club members, with the understanding that these members return to the bank two weanling gilts

Photograph from Department of Agriculture

THESE LITTLE PIGS WILL GO TO MARKET

But before that event this ruddy-cheeked youngster will have enjoyed the work of feeding, fattening, and keeping a record of the gain in weight and the cost per pound of the seven porkers, which will afford him as much pleasure and pride as could any other farm pets—and decidedly more profit in the end.

from the first litter. These gilts are in turn "farmed out" to other club members on similar terms, and the bank's holding of pigs thus increases by arithmetical progression; hence the term "endless chain."

REMARKABLE ENTHUSIASM EVINCED BY PIG-CLUB BOYS

It is not surprising that bankers find their pig-club loans conducive to the establishment of cordial relations with the future farmers and swine breeders of their communities, for the interest taken in their pigs by club members is one of the most significant phases of the movement.

This interest is reflected in thousands of letters received by instructors, club agents, Department of Agriculture officials, and the bankers themselves. There was the case of a crippled child in Mississippi last summer who became so engrossed with the project of fattening his pig that he induced his parents to allow him to move his cot to a shed near his pig-house in order that he might feed his pet at midnight. One night the pig failed to eat his usual meal with the customary piggish relish; whereupon the youthful owner hobbled to the house on his crutches and telephoned to the county pig-club agent in the adjoining town and insisted upon his coming at once to ascertain the cause for the loss of appetite.

That pigs make attractive pets and are regarded with genuine affection by their youthful masters is a fact of common knowledge to all who have followed the pig-club movement. At one of the fairs in a Southern State, when a pig had been awarded a blue ribbon the boy who had raised the animal from a weanling, oblivious of the crowd, broke into the ring, threw his arms around his pet and

Photograph by George E. Hall

"WE ARE ALL IN STYLE IN THE OZARKS; EVEN THE HOGS WEAR STANDING COLLARS"

A type of wooden yoke used in Oklahoma and Arkansas to prevent pigs from rooting their way under rail fences into pastures not intended for them. This kind of protection is not needed where the pig is well cared for and provided with an ample fattening ration.

kissed it, to the delight of judges and spectators.

BOY OF SIX RAISES A CHAMPION PIG

One of the instances to which pig-club advocates refer with special pride is the experience of Jack Starr, of Midland, Texas, who wanted to join a pig club, but learned that he was too young for membership, being only six years old. Not discouraged, however, he decided to follow pig-club rules until such time as he could join. He purchased a pure-bred pig, the runt of the litter. When the pig was 10 weeks old it weighed 29 pounds. The pet was thereafter fed, according to the pig-club agent's instructions, on a properly balanced grain ration, and was allowed to graze on Johnson grass, weeds, and volunteer oats for green feed.

Jack watched carefully for the appearance of vermin, and the few lice on his pet were easily removed with an application of grease and kerosene. A mineral mixture of charcoal, wood ashes, salt, and copperas was always kept in the pen.

When the time came for Jack to exhibit his pet at the county fair it was eleven months old and weighed 450 pounds. Not being eligible in the pig-club class, the youthful exhibitor entered his pet in five other classes, taking five blue ribbons and winning $25 in cash, with which he started his first bank account. In the following November this prize animal had a litter of nine pigs, five of which were sold for $12.50 each, and the youthful breeder is now well launched on his announced career as a stock farmer.

One of the duties of each pig-club member is to write the story of his experience at the end of the season. The narrative is usually told in simple phraseology, reflecting the earnestness of the member and his keen interest in all that pertains to his pig.

Photograph from O. H. Benson

POINTING OUT TO A PIG-CLUB MEMBER THE SCORING POSSIBILITIES OF A PROMISING LITTER

To prevent canker sore mouth, pig-club members are admonished to keep the pens clean and well bedded with fresh straw. The day after the pigs are born the little tusks on the sides of the mouth should be clipped off even with the gums, a pair of bone forceps being used for the operation. The tusks should not be pulled out, however.

THE LIFE STORY OF A PIG-CLUB PIG

Perhaps no clearer or more concise statement of the cycle of a pig's existence is to be found than in the following report made by an Indiana high school pig-club member:

"The reason that I entered the pig contest was an argument that I had with a neighbor. He said that a hog would not gain over a pound a day for any length of time. I said that he was wrong and that I would prove it to him. I immediately started to look around for a pig. Because of previous observations I had made, I decided to get a Duroc Jersey. I sent to different experiment stations for bulletins relating to hogs and read all I could about them in books and farm

FIFTY-TWO PURE-BRED DUROC JERSEY PIGS PURCHASED BY A BANK AND READY FOR DISTRIBUTION AMONG PIG-CLUB MEMBERS

Few investments have proved safer than the money spent in farming communities by banks willing to finance boys and girls eager to join the pig-club movement. In some cases the necessary capital is loaned to the boys and girls on promissory notes; in others the bank purchases the pigs and farms them out, each member agreeing to return to the bank two gilts from the first litter of bred sows (see page 174).

papers. From the analyses of feeding stuff in the bulletins, I got the addresses of the firms that sold the best feed and sent for some. I went into the contest with all my heart, because I felt that I must defend my argument.

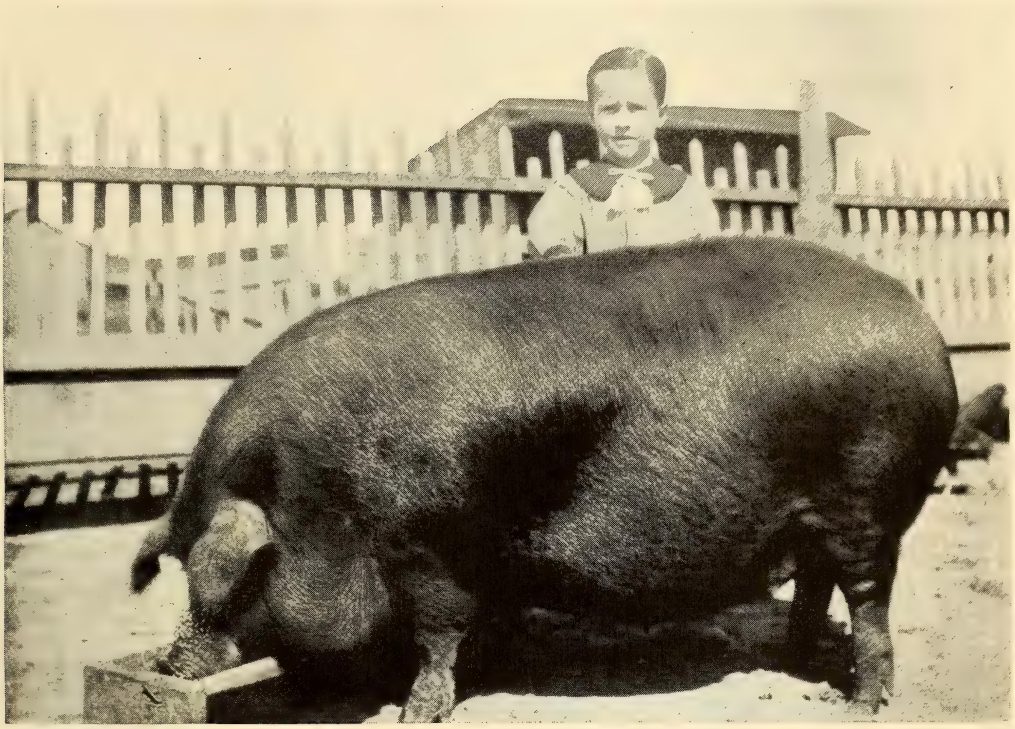
"When I got the premises I built a pig house and pen. The house was in a cool, shady place, where the sun could shine on it a few hours in the morning. Close by it I made a cement wallow and an oiler. The fence was built around the patch of rape, oats, and clover that I had sown for the pig. I made things sanitary and kept them so during the contest.

"The next step was to introduce the little red runt to his new quarters. If he was disgusted he did not show it by grunting, for after the first day he never grunted, squealed, nor rooted.

"Several things indicated that this pig needed spice for his system, and as 'variety is the spice of life,' I decided on a variety of feeds and ways of feeding which were none the worse for the pig. People must have their foods prepared differently at different meals, and as a pig comes close to being the same as some so-called humans, I prepared his feed accordingly.

"I fed only the amount of feed that the pig would clean up in a short time; consequently he ate large quantities of the pasture. I was always on the job and the pig responded, and it was not long before I had not a pig but a hog.

"The results of the contest were: the pig weighed 58 pounds at the beginning and 243 pounds at the end. He gained 185 pounds in 92 days, or two pounds a day. The cost of production was 5.03 cents a pound and the cost of the feed



JACK STARR, OF MIDLAND, TEXAS, AND HIS PRIZE-WINNING DUROC JERSEY PIG

When this pig was 10 weeks old and was turned over to Jack, as his pet, it weighed 29 pounds. Less than nine months later it weighed 450 pounds and had won five blue ribbons and $25 in cash for its youthful master.

was $9.30. The value at the end was $46.17 and the profit was $28.87.

THE CHEAP COST OF PRODUCTION

"On account of the hot weather, I kept him a few days after the contest ended, and when I butchered him he weighed 267 pounds on foot and 227½ pounds dressed. He dressed out 85 per cent. I received 25 cents a pound, which made me a total of $56.87.

"After the contest was over I wanted to see how my results compared with some other experiments, and this was what I found: Carlyle, of Wisconsin University, found that one acre of rape equals 2,436 pounds of corn meal and wheat shorts when fed in combination with these feeds. Taking one-sixth of this, although my patch was larger, it would make 406 pounds of concentrates that my pig could have eaten from the rape, not considering the oats and clover. I fed 217 pounds of concentrates and 500 pounds of milk, which is equal to 100 pounds of concentrates. Adding the three, I found that the pig could have eaten the equivalent of 723 pounds of concentrates. The Alabama Station reports that rape makes a saving of 200 pounds of grain for every hundred pounds gain. This compared favorably with my results.

"I figured that the cheap cost of production was due to three things: First, the high protein content of the concentrates; second, good health of the pig, due to great variety of feed and sanitary condition of the lot and sleeping quarters; third, the pig consumed a large amount of rape, due to good health and appetite, thus reducing the amount of other feeds.

"Another thing that I learned was that if a boy wants something decidedly interesting he should by all means get a pig and get into the game. When the contest is over he will say that he has learned

Photograph from E. Niebergall

A HAPPY BUT EVER HUNGRY FAMILY

With the dawn of their earthly existence all healthy pigs demonstrate that they have inherited that most typical of piggish characteristics, an insatiable appetite, which enables them to gain from one to two pounds in weight a day, after they are a few weeks old

Photograph from E. Niebergall

THEIR FULL DINNER-PAIL

Pigs are usually weaned when they are from 10 to 16 weeks old. Those weaned before six weeks of age usually have dairy products to rely on. The only advantage of early weaning is to enable the sow to raise two litters a year.

something that he never knew before and probably will never forget, because he learned it by experience."

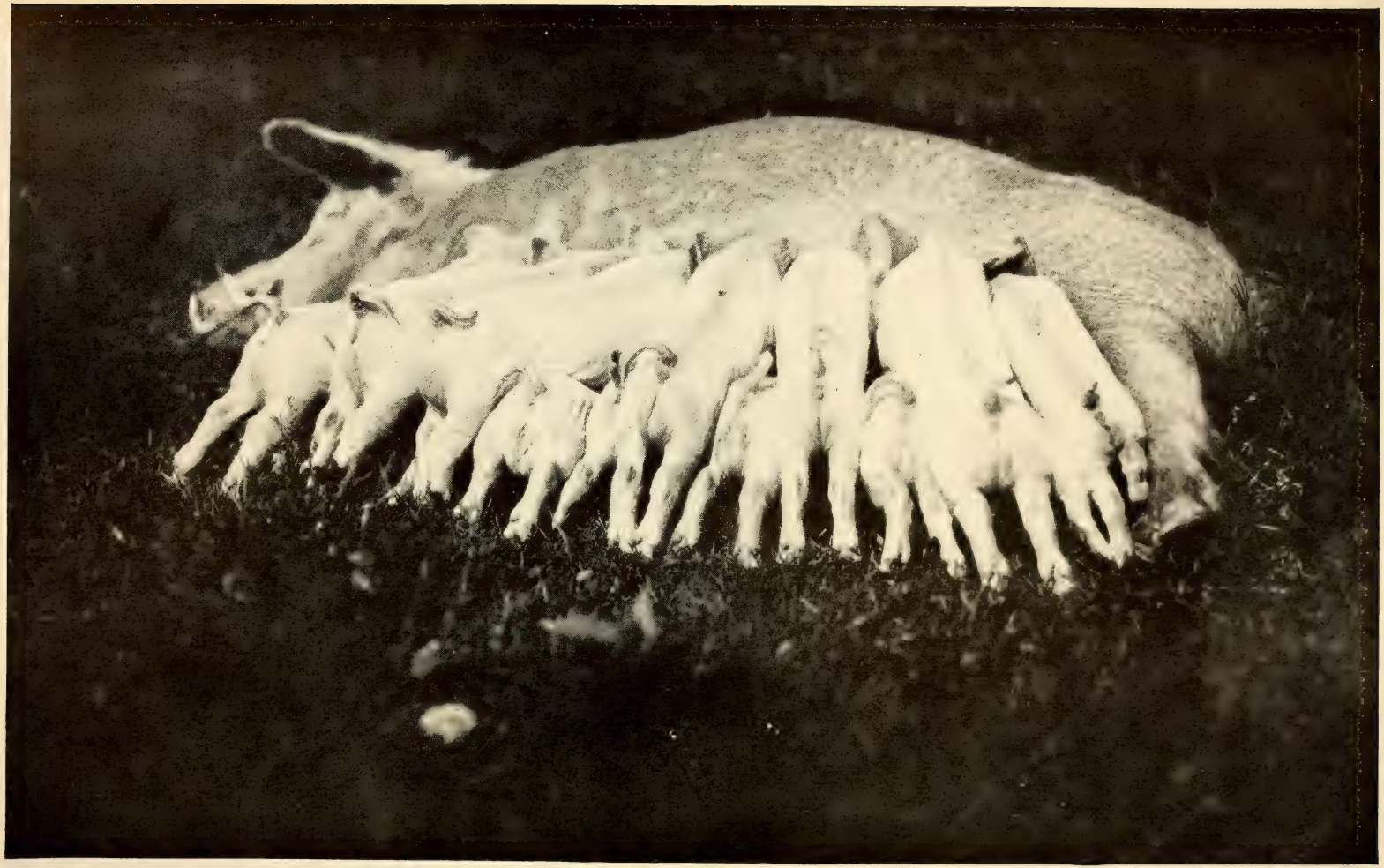
PIGS RIVAL DOGS AND CATS AS PETS

Many of the pig-club members write of their pigs with the same affectionate interest that other children speak of a pet dog, a cat, or a canary. Here, for example, is an extract from a letter by Earl West, of Garland, Oklahoma:

"Well, I shall tell you about my pig. It is looking pretty dressy since I have been feeding it digester tankage. It looks like it were fixing up for a trip. It carries its tail curled and walks as proud as if it were expecting to see town. Now I shall not disappoint him. I shall carry him to our contest on the 18th. I tell him to eat all I give him and I will do my best to get a ride on the train for him.

"He carries his fat nicely and walks up to his meals like a little boy and eats all he can. I feed him corn, oats and tame weeds, and the wastage from my father's table since my digester tankage gave out. He seems to think it is good. The funniest thing is to see him eat and look at me and grunt as if to say, 'Early, you are so good to me—everything furnished. All I have to do is to walk up and eat.'

"Now if he wins no prize I shall never be sorry about feeding him, for he shall help be a comfort for my mother and little brother at home. Besides, I enjoy his being here. While I am a member of the pig club, I tell him he must not let me get beat, for this is my first effort to do anything in the club work. But if I do get beat I shall only keep trying. My two older brothers won valuable prizes last year in the corn and cotton clubs. I shall keep trying. I am sure I can win something some day. I have one acre in corn this year, one acre in kafir-corn, and am preparing my exhibits, also my seed



Photograph from E. Niebergall

A DOUBLE-DECKER

Among farm animals the pig ranks second as a producer of human food from a given amount of digestible matter consumed. The milch cow ranks first. After the pig come poultry, steers, and sheep, in their power to convert crops of the field into food for man.

kafir-corn and corn for another year, and shall send in my report and essay when the time comes.

"The chinch-bugs got in my kafir-corn, and the drought came on my corn, but mother says I must be patient. She says that those that have no misfortune die of young age. I have always found my mother true, and I shall be patient until I get through. I am 10 years old and can always find work to do."

TEACHING THE FARMER THROUGH HIS SON

The results which have attended the efforts of food-production specialists in club work among the young people have been in marked contrast to the comparatively slow process of inducing the adult farmer to adopt modern scientific methods in raising cereals, cattle, poultry, swine, and vegetables.

One explanation for this success is the fact that boys and girls assimilate new ideas more readily than their elders. Indeed, agriculture experts are finding that the easiest method of approach to the adult farmer and the housewife is through the sons and daughters, whose signal achievements in club work furnish concrete examples of the advantages to be derived from scientific farming and the scientific breeding of cattle, swine, sheep, and horses.

For example, no number of pamphlets or lectures could be so convincing to the Decatur County, Georgia, farmer with respect to the advantages of scientific pig feeding as was the object-lesson furnished by his little daughter, who begged to be allowed to join the Decatur County Pig Club with the eighth pig of a litter. She was given the pig because the sow could only nourish seven pigs and the eighth otherwise would have starved. When the child's pig was 10 months old it weighed 225 pounds net, dressed as meat, besides yielding a 50-pound can of lard. This pig had been raised at a cost of five bushels of corn and the kitchen garbage. The other seven pigs of the litter, left to shift for themselves, averaged only 87 pounds each when butchered.

And what farm expert could have presented the story of scientific hog-raising so forcefully to a Kentuckian as the triumph of that farmer's own pig-club son when both started even with litter-mate pigs purchased at eight weeks old? The records show that the boy's pig weighed 27 pounds when purchased, and gained 167 pounds in four months, at a cost of five cents a pound—a daily gain of one and two-fifths pounds on a ration of corn, shorts, and buttermilk. At the fair the boy's sow weighed 194 pounds and took a prize; the father's weighed only 50 pounds, and there was no record of what it had cost him.

MANY BENEFITS FROM BOYS' AND GIRLS' CLUBS

The benefits derived from the pig-club movement—and similar benefits are derived from all the other club movements of the so-called Extension work of the various States, in coöperation with the U. S. Department of Agriculture—are manifold. First and foremost, the clubs stimulate an interest in swine production and teach the boys (the farmers of the future) how to raise better and cheaper hogs by the use of improved blood and the growing of forage crops. The number of hogs raised on the farm is increased and the meat required for home consumption is produced instead of bought.

The pig club is complementary to the work of the corn club, showing the members how they can market their corn profitably through hogs. The home curing of meat is encouraged on the farm. The boys are instructed in a practical way in the management, feeding, sanitation, and prevention of disease of swine.

One of the chief advantages which is being derived from this movement is the means which it affords boys and girls of earning money for themselves while at home, and at the same time awakening a real and abiding interest in farm life—a powerful back-to-the-farm movement inaugurated at the very source.

While emphasis has been laid here upon the pig clubs, the canning clubs, poultry clubs, baby-beef clubs, potato clubs, corn clubs, and sheep clubs are no less vital to the welfare of the nation and to the increase of our agricultural re-

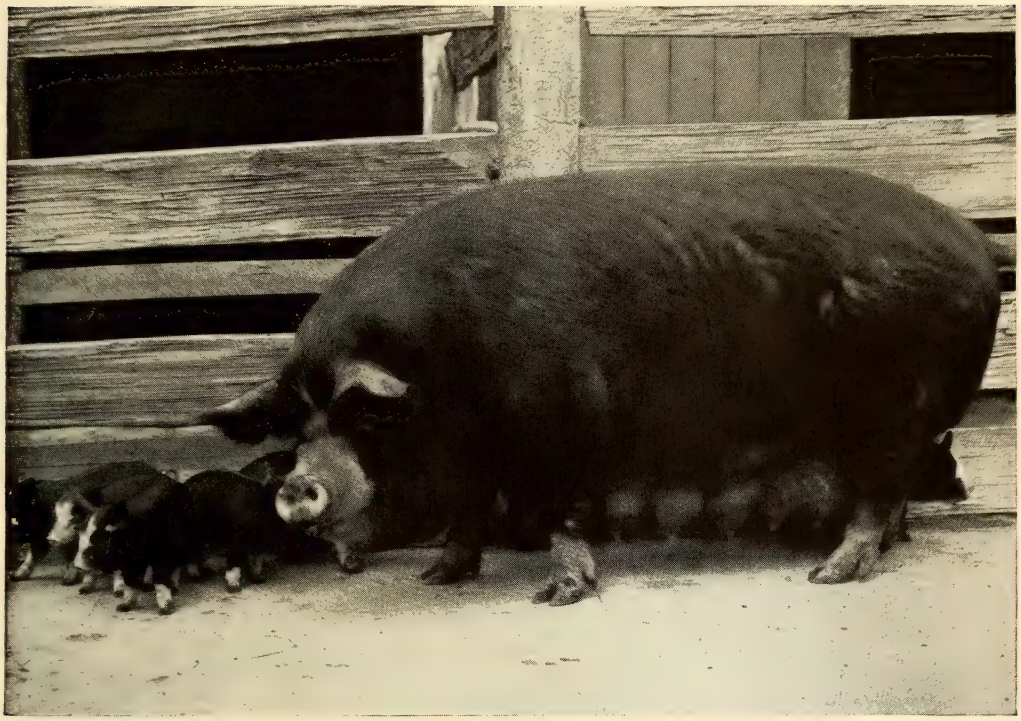
Photograph from E. Niebergall

A PIG'S KISS

Photograph by A. W. Cutler

PRACTICING THE SECOND PRINCIPLE IN THE PIG'S SCHEDULE OF LIFE—EAT, SLEEP, AND GROW FAT

When the pigs are asleep the chicks become bold, a revised version of "When the cat's away." The biddy at the right is trying to make up its mind whether it is safe to approach any nearer and peck the insect which the owner of the pigs overlooked when the bristles were treated with lard and kerosene to remove vermin.



Photograph from Janet M. Cummings

A FAMILY OF WHICH ANY CLUB MEMBER WOULD BE PROUD TO CLAIM OWNERSHIP

But this is not an American sty-hold. This sow is rearing her litter in Australia, one of the great meat reservoirs of the world.

sources. They are interdependent and mutually stimulating. It frequently happens that one active boy or girl is a member of several clubs, doing equally efficient work in all. In other cases different members of the same family belong to different clubs and there is wholesome rivalry as to which will realize the greatest profit and capture most prizes in his or her particular field of activity.

THREE PRIZE-WINNERS IN ONE FAMILY

A notable instance of family coöperation is to be seen in the achievements of the three White boys of Norwood, Madison County, Tenn. Each sent into the county club agent his record book illustrated with excellent kodak pictures, and each picture was adorned with a small American flag in the corner, indicative of the patriotic spirit of these young soldiers of the commissary.

Bronson White raised 120 bushels of corn on his club acre, and after deducting $20.35 for expenses (including $5 for rental of the land) he had a profit of $129.66. He also won a $10 prize in the boys' corn club contest, and with this money purchased from his older brother a registered Poland China pig, which he "thinks will make a prize-winner."

Robert White produced 140 bushels of corn on his acre, which was sold for $175, giving him a net profit of $153.88. With a part of this money and $32 which he won in prizes he purchased half interest in a small flock of sheep, and in connection with this investment he adds the following postscript to the history of his corn-club activities:

"The sheep is one of the most money-making animals you can raise on the farm. Boys, just think about 18 pounds of wool off one ewe at 75 cents a pound and $50 for her twin lambs at five months old—$63.50 for wool and lambs. Then I took her to the fair at Jackson and won $6 over Obion County's best sheep breed-

Photograph by A. Moscioni, from Lt. Adolfo de Hostòs

PACKING PIGS TO MARKET IN PORTO RICO

A comparatively comfortable method of transportation for both man and beast; but if this native Porto Rican had practiced pig-club methods, he would have so much pork on his shoulders that he would scarcely be able to stagger under the load.

Photograph by Emil P. Albrecht

"A CORNER IN PIGS": MARKET DAY IN ST. BRIEUC, FRANCE

Scrubbed till its skin glows pink through glistening white bristles, the St. Brieuc pig, in its rope harness, is a thing to admire, no less than the many different types of headdress worn by these thrifty Breton women. Each type of cap bespeaks the village from which the wearer and her pig hail.

ers. Now, adding that to the other, she netted me $69.50 profit, and I still have the ewe!

"Yet I have heard farmers say that they did not like sheep. But, boys, give me rich land to work, warm clothes to wear, and a stomach full of barbecued lamb, and Bob White does not mind putting his shoulder to the wheel."

A BOY'S PLEA FOR MORE HOGS

The third and oldest brother, J. B., raised 145 bushels of corn on his acre, the net profit on which was $159.90.

With the profits from his previous corn-club crop, J. B. purchased 20 pigs, which then weighed 33 pounds each, but which at the time of his report averaged 402 pounds. He enclosed with his report a picture of three of his porkers, "Billy Sunday," "Mattie L.," and "Tennessee Bell," and of these he writes:

"Billy Sunday won first prize under one year in the Poland China ring. Mattie L. did the same thing in her class. Tennessee Bell, the little Hampshire pig I won in the boys' corn club last year, weighed 33 pounds. I brought her home in a cracker box. This year she won first prize under one year in the Hampshire ring, and also champion over all breeds and ages.

"These pigs were raised on crimson clover, alfalfa, and soy-beans, with very little corn—about one ear a day. They are now running on a field of soy-beans and peas without any corn.

"Boys, we ought to raise more hogs and especially brood sows to produce an early fall litter. We can do it if we will provide good grazing, so that they can get a large part of their food. The forage crops should be grown to save the corn, so that we can raise the pigs much cheaper.

Photograph by G. Heurlin

"SPEAK FOR IT"

Many of the pig-club boys and girls manifest the keenest affection for their pork-producing pets, and occasionally there is a most pathetic note in some of the letters received by the pig-club agents when lightning, a train, or hog cholera kills the animal upon which time and labor have been lavished. "You can mark my name out," wrote one boy. "My pig is dead; I ain't got no money to start with again and no feed. I am in a bad fix for starting and I will have to give it up."

Photograph by G. Heurlin

PURE-BRED AND HAND-FATTENED

There are two distinct types of swine—the lard and bacon types. The lard type is much preferred in the United States, while the production of choice bacon is more general in those countries where the feed of the hog is more varied and where corn is not the principal fattening grain.

Photograph by G. Heurlin

FOUR LITTLE PIGS

Instead of being the unclean, insanitary creature almost universally depicted, the pig is much more cleanly in its habits than the dog. It makes a desirable pet for youngsters living in the suburbs as well as on the farm.

Photograph by G. W. Groff

WICKER-BOUND PIGS BEING TRUNDLED TO MARKET ON CRUDE WHEELBARROWS: CANTON, CHINA

The thrifty yellow race knows how to make the most of its meat resources. A poor pig is seldom seen in China.

"Boys, stay on the farm and come to see me after hog-killing time and I will feed you on back-bone, spare-ribs, sausage, ham, and red gravy."

In the hands of such youthful farmers the ample productivity of American soil is assured.

HOW YOUNG PATRIOTS MAY ENLIST

All young patriots who are willing to offer their services in the cause of producing more food for our own soldiers and our allies, and who at the same time wish to earn a handsome profit on their investment and experience the joy of watching growing things—pigs, sheep, corn, calves, etc.—should write either to the Agricultural College of their State or to the Department of Agriculture, Washington, D. C., stating in which club they are interested.

A State or county agent will immediately answer such inquiries and furnish accurate information as to the best meth-

Photograph by Deck Lane

ON A PENNSYLVANIA FARM: THE PET-SHEEP MOVEMENT IS FINDING FAVOR IN THE EASTERN AS WELL AS THE WESTERN STATES

A sheep can be raised as cheaply as a dog and ordinarily will produce $5 worth of wool annually. When reduced to mutton it will average $10 in value. A sheep-club boy in Tennessee reports having secured 18 pounds of wool from one ewe ($13.50), and sold her twin lambs when five months old for $50—a total of $63.50 for wool and lambs—and he still has the ewe (see page 185).

Photograph by R. R. Sallows

PICTORIAL EVIDENCE WOULD SEEM TO INDICATE THAT CANADA HAS ORGANIZED BOYS' PUMPKIN CLUBS

AMERICAN FARMERS ARE BEING TAUGHT SCIENTIFIC AGRICULTURE THROUGH THEIR SONS AND DAUGHTERS

The corn clubs and pig clubs are closely related. It was to provide a profitable method of marketing the boys' corn harvests which first suggested the idea of pig clubs to a rural school superintendent in Caddo Parish, Louisiana, eight years ago.

ods of raising pigs, of planting corn, etc. This information is supplied without charge, and the government agents will gladly give expert advice, call wherever possible to see those interested, and enroll them as club members, all without cost to the individual.

No attempt has been made in this article to set forth the methods of pig-raising or to describe the relative merits of such breeds as the Duroc Jersey, the Poland China, the Berkshire, and Hampshire. All these subjects are treated in very complete and interesting detail in the various Department of Agriculture bulletins, which are sent free, upon request.

Boys and girls living in the New England and Middle Atlantic States are especially urged to join the club movement. Their proximity to many large cities insures a constantly brisk market for farm, dairy, and meat products, and all food raised in this section of the country not only adds to the general larder of the nation, but relieves to some extent the ever-increasing transportation burden which must be borne by the government-operated railroads.

From April to November the weather is sufficiently mild in the North and East to warrant the raising of pigs in the open, without the outlay of large sums for housing equipment.

Among the Eastern States, Massachusetts has been commendably active in boys' and girls' club work. In that Commonwealth the popularity of the pet-pig movement has been second only to the interest shown in poultry clubs. New York promises to do much in this direction also, although the club work was not begun in that State until March, 1916.

Particular emphasis should be placed on the fact that a large tract of land is not requisite to the keeping of a pet pig. On a small lot in the suburbs a young porker can be fattened at negligible cost, being fed largely on kitchen waste.

BILLIONS OF BARRELS OF OIL LOCKED UP IN ROCKS

By Guy Elliott Mitchell

Of the United States Geological Survey

IS THE United States facing a gasoline famine? Shall we be required to forego automobiling except to meet the stern necessities of war and of utilitarian traffic? Are our petroleum fields showing signs of exhaustion?

The output of petroleum has not yet begun to diminish; statistics show that it is still increasing; yet the downward trend of production from the present oil fields is plainly in sight.

The war has made a sudden and enormously increasing demand on the oil fields of America, and though the industry has never been so feverishly active as it is now and the output never so large, the truth is that the demand has not been entirely met. And during the next year and as long as the war lasts the demand will be ever increasing, ever more pressing.

Many of the host of larger vessels that we are now building will be equipped with oil-burning furnaces, and the vast swarm of airplanes that we are building, as well as the thousands of war automobiles and trucks that we are turning out, will consume an enormous quantity of gasoline. Yet no great new oil regions comparable with the mid-continent or California fields are being discovered, and it is questionable whether any will be, for our oil geologists have pretty thoroughly combed the accessible oil areas. What, then, is the answer?

It is just at this juncture that we have made a discovery that has disclosed what is undoubtedly one of our greatest mineral resources—one that should supply the needs of the war, and that for generations to come will enable the United States to maintain its supremacy over the rest of the world as a producer of crude oil and gasoline and incidentally of ammonia as a highly valuable by-product. We have discovered that we possess mountain ranges of rock that will yield billions of barrels of oil.

For many years travelers going west through the Grand River Valley of Colorado and into the great Uinta Basin of eastern Utah have looked from the windows of their Pullman cars on the far-stretching miles and miles of the Book Cliff Mountains, little realizing that in these and adjoining mountains, plainly exposed to view, lay the greatest oil reservoir in the country—the oil shales of Colorado, Utah, Wyoming, and Nevada.

ROCKS THAT BURN FREELY

These shales, it is true, were known to yield oil. Campers and hunters in building fires against pieces of the rock had been surprised to find that they ignited and burned, and investigation showed that they contain oil. This fact was looked upon, however, as only another of the natural curiosities of the great West and little or no attention was paid to it because of the seemingly inexhaustible pools of crude petroleum found elsewhere under great areas.

In connection with its investigations of the undeveloped mineral resources of the country the United States Geological Survey has recently made special studies and tests of these oil rocks and has brought to light two important facts: First, that our western shales are phenomenally rich in oil, and, second, that in foreign countries, particularly Scotland, much inferior shales are today successfully mined and worked as a source of oil and other commercial products. The industry in Scotland is 70 years old and is still in a highly flourishing condition.

OIL PROFITABLY DISTILLED FROM SHALE IN SCOTLAND

The Scotch shales run only about 25 gallons of oil to the ton; yet the principal operating companies competing with the petroleum industry pay annual dividends averaging 18 per cent. Rock producing

Photograph from U. S. Geological Survey

GEOLOGICAL SURVEY MEN SAMPLING ONE OF THE GREAT OIL SHALE BEDS NEAR GREEN RIVER, WYOMING

As the great Creator, through His servants of old, caused water to flow from the rock in the wilderness, so, through twentieth century science, He is causing oil, for ages locked up in the shales of America, to be released for the relief of human necessity.

Photograph from U. S. Geological Survey

GOVERNMENT GEOLOGISTS AT WORK ON AN OIL SHALE DEPOSIT NEAR WHITE RIVER, COLORADO

The results of the experiments in distilling from Colorado oil shale have been so promising that a reserve of 132,000 acres of the richest region has been set aside by the government as a source of the oil supply for the United States Navy.

Photograph from U. S. Geological Survey

IN THESE WYOMING ROCKS ARE LOCKED MILLIONS OF BARRELS OF OIL

These deposits of oily rock are often massive in extent as well as in thickness. Beds were recently reported in one Western State over an area of 1,500 square miles, averaging 20 feet in thickness and yielding at least 36 gallons to the ton.

even as low as 20 gallons of oil a ton is yielding good dividends. The shales in the western United States are far richer in oil than those of Scotland. Many tests made by the Geological Survey show that the American rocks contain 40 to 50 gallons to the ton and those in one deposit tested 90 gallons, or more than 2 barrels, to the ton.

To extract the oil, the rock is distilled at a low temperature. So simple is the process that the geologists who surveyed the fields carried small testing retorts around from place to place to determine the oil content of various specimens.

In the Scotch plants the rock is heated in retorts arranged in banks of four over a single fire-box, and a unique feature of the process is that the gas derived from the shale is the fuel used for obtaining the oil and other products. The retorts are grouped in benches of 64 and each retort reduces about 4 tons of rock a day. Some 3,000,000 tons are treated annually. The vapors pass from the retorts into condensers in which the crude oil is deposited, and then on into a chamber in which the ammonia is collected.

The Scotch shales yield gasoline, illuminating, lubricating, and other oils, paraffine wax, and sulphate of ammonia, besides a considerable quantity of liquid fuel and the gas that is used in the plants.

QUANTITY OF OIL IN AMERICAN SHALES ENORMOUS

The total production of petroleum in the United States up to 1918 has been 4,255,000,000 barrels, and the possible future production, or the total reserve in the ground—and some of it lies very deep—is estimated by the Federal Government at about 7,000,000,000 barrels.

How does this petroleum compare with the known oil-shale reserve? The quantity of oil that can be extracted from the

Photograph from U. S. Geological Survey

AN OUTCROP OF RICH OIL SHALE IN UTAH

The flexibility of the rock indicates its heavy oil content. The oil shales of Scotland, which have been profitably worked for 70 years, yield about 25 gallons to the ton of rock. The shales of the western United States run about 40 or 50 gallons to the ton and those of one deposit gave 90 gallons to the ton.

shale is so huge that the petroleum reserve becomes almost insignificant by comparison. As a result of only a partial investigation, it is estimated that the oil in the shale ranges of Colorado alone amounts to 20,000,000,000 barrels. There are mountains—indeed, ranges of mountains—which for many miles carry thick beds of rock that yield 30 to 50 barrels of oil to the ton.

More recently the State geologist of Colorado has reported that in northwestern Colorado beds of commercially workable rock that average more than 20 feet in thickness and that will yield at least 36 gallons of oil to the ton are found in an area extending over 1,500 square miles. These figures show a content of 24,000,000 barrels of oil to the square mile, or a total of 36,000,000,000 barrels for the area. Either twenty billion or thirty-six billion is sufficiently impressive.

The Geological Survey also estimates that 300,000,000 tons of sulphate of ammonia, worth, at before-the-war prices, about $60 a ton, could be recovered as a by-product in the extraction of the oil. This by-product would be sufficient to enrich most of the farms in the great Mississippi Valley.

In addition to the oil rock in Colorado, that of Utah must be considered. The government is now investigating these deposits in detail and has already stated that they are probably as extensive as those in Colorado and are equally rich in oil. Oil shales have been examined also in Nevada, Wyoming, California, Montana, and other States. Tests of specimens from Wyoming show from 30 to 50 gallons to the ton, and samples from Nevada have produced from 40 to 100 gallons of oil to the ton. One 10-foot

bed in Nevada yielded oil at the rate of 13,000,000 barrels to the square mile.

DEPOSITS IN EASTERN STATES

But the West has no monopoly of the oil-shale resource. Deposits have been examined by the government in Illinois, Kentucky, Ohio, Pennsylvania, Tennessee, West Virginia, and Indiana, some of them testing out with a high oil content. An examination of the black shale of southwestern Indiana shows that it underlies about 16,000 square miles, and although the oil content of much of it is less than that of the western shales, and some of it is too low in oil to be worked commercially, the actual content for the area in Indiana alone would be 100,000,000,000 barrels.

Some of the eastern shale that is very rich in oil overlies extensive coal beds, which are being mined by the "stripping" method, so that the oil rock must be removed in any event to get out the coal. This shale could therefore be mined by steam-shovels without additional cost, as it is a necessary preliminary to the coal-mining.

The potential value of this immense oil resource of America is almost beyond comprehension. Enough oil is held in these natural reservoirs to fill many times over every tank, cask, barrel, can, and other container of every kind in the world.

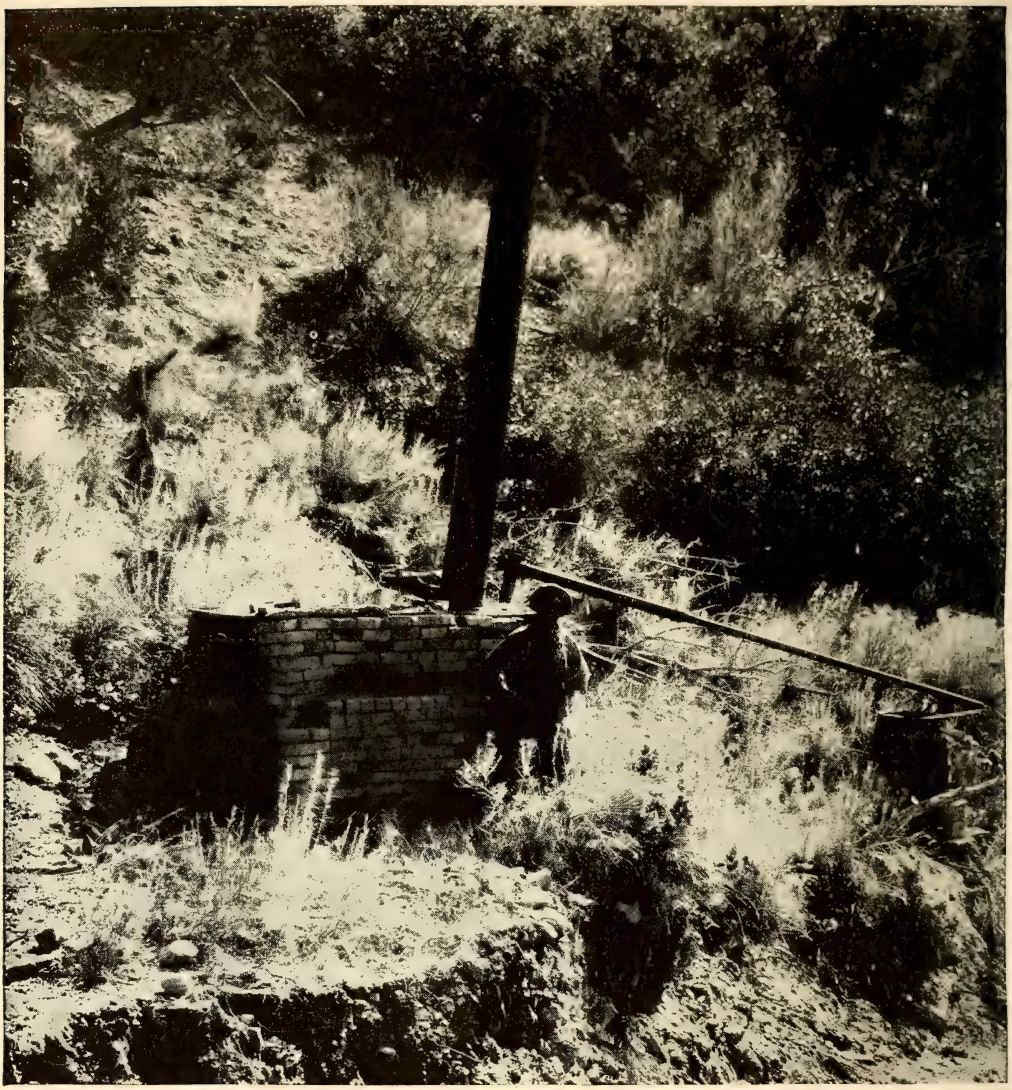
Until recently the oil shales of the United States, particularly those of the Western States, have been referred to by the government geologists as a reserve available for extraction whenever the demand and the price shall become great enough to warrant the establishment of a new industry to supplement the supply of petroleum from the oil fields. This time is now at hand.

The extraordinary demands of the war are already indicating the approaching insufficiency of the output from our petroleum fields, and experiments in the utilization of oil shale are already being made in Colorado. Plants are being erected, oil is being distilled, processes are being tested, and a steadily increasing output is soon to be expected. So substantial is this resource considered that the government has set aside as a special

Photograph from U. S. Geological Survey

HAND DRILLING TO SECURE UNWEATHERED SAMPLES OF OIL SHALE

The deposits of oil shale in the Rocky Mountain region lie for the most part near the surface and can be mined by steam-shovels. By situating the reducing plants in the valleys, gravity may be utilized in transporting the rock to the distilleries.



Photograph from U. S. Geological Survey

OLD SHALE DISTILLERY NEAR JUAB, UTAH, USED BY MORMONS A GENERATION AGO

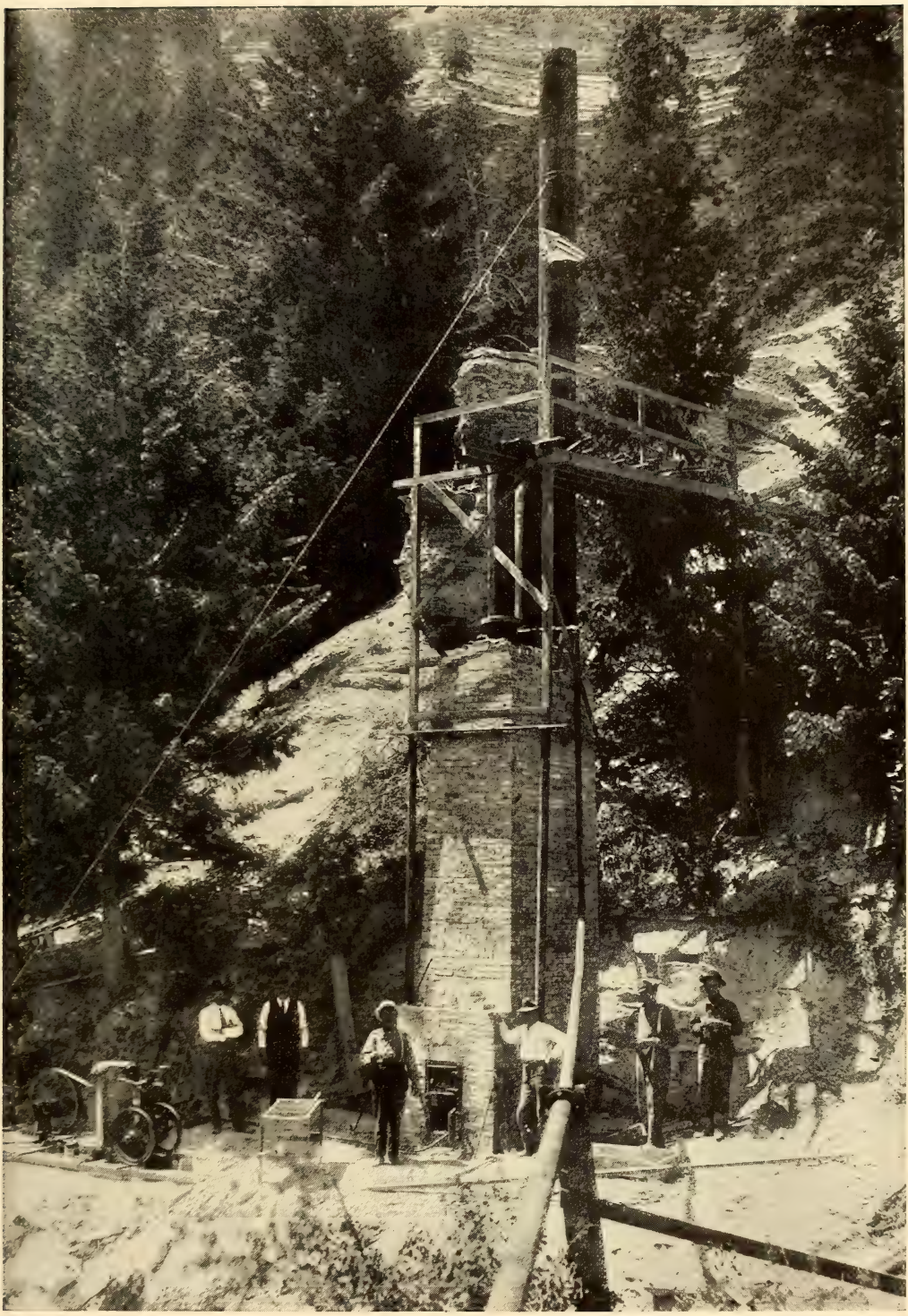
When the oil is distilled from the impregnated shales there comes with it a great supply of those yellowish crystals we call sulphate of ammonia—a fertilizer so rich that it would make a garden out of an old abandoned field. Three hundred million tons of this great soil vitalizer lie locked in the shales of Colorado alone, waiting to be released by the key of industry.

reserve for the American Navy 132,000 acres of the richest oil-shale land in the West.

BEWARE OF FAKE PROMOTERS

It is not to be understood, of course, that any farmer or rancher who may happen to have oil shale on his homestead can produce oil at a profit. Successful oil distillation will require large and expensive plants, well financed and scientifically managed, as in any other large industry.

It is by no means a poor man's proposition; but neither, on the other hand, is it a highly complex and involved industry, such, for instance, as beet-sugar manufacture, while the fact that oil dis-



Photograph from U. S. Geological Survey

NEW EXPERIMENTAL OIL STILL NEAR DEBEQUE, COLORADO

No man who owns a motor-car will fail to rejoice that the United States Geological Survey is pointing the way to supplies of gasoline which can meet any demand that even his children's children for generations to come may make of them. The horseless vehicle's threatened dethronement has been definitely averted and the uninviting prospect of a motorless age has ceased to be a ghost stalking in the vista of the future.

Photograph from U. S. Geological Survey

WASH DAY IN A U. S. GEOLOGICAL SURVEY CAMP

Campers and hunters in the West long ago discovered that oil shale would burn. A few rich samples are here supplying the heat for the camp laundry.

tillation is well established in other countries is tremendously to the advantage of prospective development in the United States.

Unfortunately the discovery of the immense oil resources of America, contained in its oil-shale deposits, will doubtless be attended by misfortune for the unwary—those who invest carelessly in the stock of fake or "wild-cat" oil companies, organized by get-rich-quick schemers who are intent upon exploiting the gullible public rather than the development of oil-shale properties. Such schemers, like camp-followers, appear in the wake of every great discovery of mineral wealth and they have always found the "oil fields" a particularly lucrative one for their operations.

AMERICAN OIL-SHALE INDUSTRY WILL FAR OUTSTRIP SCOTLAND

The success attained by the oil-shale industry in Scotland indicates far greater

Photograph from U. S. Geological Survey

RICH OIL SHALE LEDGE OUTCROPPING NEAR GRAND VALLEY, COLORADO

Although the oil reserves of the United States are greater than the amount produced in the entire world from the birth of the industry until now, yet the output at the present time is such that it would exhaust the reserves in 30 years. But now comes the discovery of such an abundance of oil in American shales that all the oil produced in the whole world in the entire history of the industry is only a drop in the bucket in comparison with the supply the rocks offer us.

Photograph from U. S. Geological Survey

A MOUNTAIN CONTAINING MILLIONS OF TONS OF RICH OIL ROCK AT THE VERY DOOR OF TRANSPORTATION: MOUNT CALLAHAN, IN THE GRAND RIVER VALLEY, COLORADO

The immensity of the coal beds of America is overpowering, and yet they represent but a small percentage of the coal originally laid down. Between the glaciers that ground out billions of tons and the crust-crumpling processes of the earth that buried other billions of tons, great as is the amount of coal left, it is only an insignificant share of the original deposits. But though most of our coal was taken from us before we came upon the earth, some of it comes back to us in one shape or another. Petroleum is one of its proxies; oil-bearing rock is another.

success for the industry in the United States. Not only is the oil content of the American deposit larger than that of the Scotch—in some cases more than three times as large—but the American rock can be mined more cheaply.

The Scotch shales lie far below the surface and must be mined by hand and hoisted through shafts like coal or hauled up inclines. Most of the Rocky Mountain shale lies from a few feet to 2,500 feet above the valley floors and much of it can be mined in a wholesale manner by steam-shovels and lowered by gravity to the reducing plants.

OIL FORMERLY DISTILLED FROM SHALE IN PENNSYLVANIA AND UTAH

The Scotch shales occur in irregular beds which here and there thin out and have been thrown into geologic faults and folds that greatly increase the cost of mining. The western shales, on the other hand, are more uniform in thickness and lie in a horizontal position. Despite their handicaps, the Scotch deposits are worked at a large profit, yet their average content of oil is only about 25 gallons to the ton, whereas vast quantities of easily mined American shales that lie in benches 6 to 10 feet thick will average perhaps a hundred per cent more oil.

Oil-shale distillation is not new in the United States; yet it is doubtful if there are many people alive who remember anything about the earlier industry. Before petroleum was discovered in Pennsylvania, about 50 small companies in the eastern United States were crudely distilling oil from shales; but after subterranean pools were discovered these companies went out of business.

Long ago the Mormons also distilled oil from shale near Juab, Utah, where the ruins of an old still can yet be seen. We are now about to return to this discarded industry and produce hundreds of millions of barrels of oil where formerly the output was comparable to the production of oil from sperm whales.

AMERICA'S IMMENSE MINERAL WEALTH

The discovery of these vast deposits of oil-bearing rock in the United States, the petroleum content of which can be estimated in nothing less than hundreds of billions of barrels, is one more evidence of the abounding wealth of the North American Continent. No sooner does one of our resources show limitations in production and the pessimists begin to cry, "What shall we do when our reserve is gone?" than immense additional deposits or satisfactory substitutes are discovered.

During the last few years petroleum, with its most valuable constituent, gasoline, has become one of our most vital resources, so than even the most cheerful optimist might well begin to question the immediate future prospects of the industry; but with thousands of square miles of rock lying above ground, within sight of trunk-line railroads and constituting an unfailing oil reservoir, we can feel assured of a supply of gasoline for many generations to come.

The United States is indeed a country blessed by a generous Providence. Germany, to supplement its stock of petroleum and gasoline, laboriously raises potatoes from which to distil fuel alcohol; but here in America there are mountains of oil rock which can be blasted and steam-shoveled and transported by gravity to great retorts which will turn out oil and fertilizer in limitless quantities.

The production of oil in this country, instead of decreasing, will continue to grow; it will even, because of the shale resource, greatly increase its present immense output of 340,000,000 barrels a year and will keep pace with the enormously increasing demand. No one may be bold enough to fortell what tremendous figure of production may be reached within the next ten years.

SHOPPING ABROAD FOR OUR ARMY IN FRANCE

By Herbert Corey

FOUR hundred shiploads of things the American Army needs in France have been bought in Europe.

I know of no more blunt and uncompromising way of beginning this story of a big job. It lacks color and voltage. It really should be illustrated by a diagram showing a procession of four hundred tall ships sailing into a port in France, each loaded down to the captain's quarters, while a fleet of toothless U-boats gives way to *furor Teutonicus* on the side lines. That would bring home to the reader what this achievement of the Purchasing Board in France really amounts to.

Each ton bought in Europe lessens by 2,000 pounds the strain on the tonnage line that connects the American Expeditionary Force with its home base. One might go into the dollar feature of the situation and show that each ship will cost the American Government not less than $10,000 a day, and that they will average 60 days to the round trip; but that phase is relatively unimportant. The essential point is that an enormous ocean shipment, with its attendant risks and delays, was avoided in this way.

SHORTAGES IN ALL DEPARTMENTS EXCEPT THAT OF COURAGE

The 400 shiploads only include the material bought by the Army Purchasing Board in France. A huge quantity of other goods has been bought by the commanding officers of units, these ranging from the day's rations to footwear and ready-made huts. Such purchases, however, are of the hand-to-mouth order and only satisfy the moment's needs. The greater purchase may be charged to capital account. The goods were needed for permanent equipment. They are the shelves and counters needed for Uncle Sam's new business abroad.

Every one now knows the conditions under which the American army began operations in Europe. Some thousands of men had been hastily gathered together, herded on steamers, and pelted off to France. Probably every one knows that, thanks to our failure to take out insurance before our house caught fire, this first expeditionary force only outwardly resembled an army. Seventy-five per cent of the men were rookies; some of them took their first steps before a drill sergeant on board ship. The bureaucratic chair-fillers at Washington, who used to send men to Manila wearing the clothes designed for blizzardly afternoons on Skagway Pass, were living up to their own best worst. There were shortages in every department except that of courage.

In the United States every one became busy—and talkative—at once. The columns of good news about things that were sure to take place, if nothing happened, must have sent thrills down the backbone of every good American. In France, General Pershing had no time for prognostication and hurrah.

Persons who think they know commanding generals who have had harder tasks than Pershing in this war are invited to name their candidates. He was not only responsible for those preliminary arrangements of a purely military character, which will lead to victory later on, but he was obliged to create overnight a huge business organization. He became the head of an enterprise that could put the Standard Oil octopus in its pocket and never feel it squirm.

SOME OF THE DIFFICULTIES OF THE SITUATION

The American army is 3,000 water miles away from its home base, in a country that is increasingly feeling the strain of more than three years of war. The number of Americans in France was added to each week.

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CANNED GOODS ARE A STAPLE OF THE AMERICAN SOLDIER'S DIETARY IN FRANCE

"But 'airtights' take up a frightful lot of space on shipboard, and besides, there is plenty of fruit to be had in France. To bring American canned goods to a country where every peasant makes a pet of a pear tree is like carrying coals to Newcastle. So the tin is to be brought over in sheets and made into cans in French shops, and next summer the farm women of France will put up canned goods for American soldiers."

With that growth of the army the daily needs for clothing and food grew in proportion. Reserves must be built up to provide against possible hard times ahead. Artillery must be furnished, for Uncle Sam reacted with a jerk to the discovery that the squirrel rifle of our daddies is no longer useful, there being few squirrels in France. Transportation must be furnished on an unprecedented scale. New railroads must be built and equipped and old railroads furbished up. Three-ton camions take the place of mules in hauling food for a modern army; but mules are also needed.

As the wants increased, so did the difficulties. U-boats are daily sunk in the editorial columns, but manage to maintain a certain liveliness on the high seas. No particular genius was required to demonstrate that every possible pound should be bought on the European side of the Atlantic, to loosen the tension on tonnage. But genius was needed in the buying, in order that America's allies should not be hampered. France and Great Britain and Italy are taking practically all the European market can supply, and their troops are fighting. It would not be good strategy to rob fighting forces to favor an army which is practically non-combatant as yet.

WHERE KITCHEN DIPLOMACY ENTERED

A matter of kitchen diplomacy entered into the problem also. The moment that American food purchases began to swell the prices in the village markets the French housewife would certainly protest. Her budgetary curve has been downward, for the most part, while the cost-line of cabbage and sugar has been steadily warping up. It would never do to allow the deep American pocket to

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LOADING A TRANSPORT WITH TROOPS AND SUPPLIES FOR FRANCE

"Every business operation is figured in tonnage terms nowadays. The great question is how the tons can be saved. Almost as soon as the Americans reached France the camp buckets and pots and kettles and pans were identified as space-wasters in shipholds. So the tin and galvanized iron are now taken over in the raw. Henceforth these minor and clangorous items will be manufactured in French workshops."

enter into competition with her slender purse. It would neither be wise nor, as Americans say, "decent."

So a formula was worked out for the buying. It might be stated something after this fashion:

"Save tonnage today if we can pay back tomorrow; mortgage the future.

"Always give the fighting forces the first chance.

"Ladies first."

Some one suffered from a constriction of the imagination when the body that does the buying in Europe was named the Purchasing Board. It is libeled by so tame and commonplace a title. Its members make purchases, to be sure, but that is only one phase of its activities. Now and then it lapses into diplomacy. It negotiates with European labor and adjusts the American machines and ways of doing things to continental men and women. It is in the manufacturing business. It is turning over every shop in neutral Europe in search of raw material. And it all began in the mildest way possible.

GENERAL PERSHING'S BIG TASK

General Pershing began it, of course, for in the army all things begin and end with him. One reason why his job makes such a tremendous appeal to the imagination is that it is this sort of a job. He is not only creating an enormous business organization, but he is catching the men to run it. Sometimes he does not catch the right man, and then he has to take a few minutes off to catch the wrong man and fire him. But an organization is being created. When it gets on its feet it will stand comparison with any organization in the world. It would be folly to say that it can stand alone today.

"I must have coal," he told the man who is today the chief purchasing agent. "Go out and buy it."

I have promised the chief purchasing agent that I will not use his name, but it is only fair—to the army—to say that he was the head of a great bank in a great mid-western city. He was a business man, too, of the sort who is not afraid either of money or men. When the United States went to war he volunteered. He is still, praise be, a business man.

When he came into Pershing's office he was probably told to sit down and have a cigar, and asked if he had seen any U-boats on the way over, that being considered a neat conversational opening in France nowadays, and before he could answer he was told that the American army needed coal and that it was up to him to get it.

HOW THE PURCHASING OFFICER ACHIEVES RESULTS

Well, he got the coal. But before he got it he negotiated with two European governments and the heads of some European labor. He had to find a way to have ships commandeered, not having any handy way to commandeer the ships himself. There was even talk of reopening some of the coal mines that France has temporarily abandoned on the central plateau because of a lack of labor, but that plan was given up for various reasons.

The whole secret of the job was that the American army *had* to have coal. At the moment there were 6,000 tons on hand; 10,000 tons were owing to the French Government; there was none in sight, and winter was coming on. That was a standard condition in all lines during the first days of the American activity in France.

The chief purchasing officer and his assistants got the things needed because they know how to hustle. I was in his office one day when a major, whose name and millions have been a Sunday feature in New York for twenty years, came in. The outlines of the feature have not changed materially. They consist mostly of dollars.

"I'm out of a job," said the major.

"Go to French headquarters," said the chief purchasing officer, "and get some stuff out of storage."

Before the major was out of the room the stenographer was telegraphing headquarters that the appointment of Major Money as liaison officer at French headquarters was desired. The appointment came back by wire before the major got to French headquarters. That is the sort

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U. S. MARINES IN FRANCE OFF FOR TRAINING CAMP

"Railroad cars were found here and there. One would not think that so conspicuous a thing as a railroad car could be lost, but they have assuredly been found. The explanation is that France has had no men to spare for repairing cars. The derelicts had been cast away in railroad backwaters. American scouts found them and American mechanics were set to work making them over."

of speed they are showing in the Purchasing Board. The chief purchasing officer likes to hustle—and anyhow it is forced on him.

"The French expect us to hustle American fashion," said he. "They would be disappointed if we did not. What else can we do?"

EVERYTHING NEEDED AT ONCE

Everything was needed at once. Cloth for uniforms was bought in England, along with shoes and hats and blankets. France furnished cannon and tents, and pots and pans, and food. The rooky army was billeted in peasants' cottages until material for huts could be found and the huts built.

Paris was drained dry of all sorts of office material. I doubt if there is a good desk or filing cabinet or revolving chair to be found there today. The American army reached France as bare as a fish and it had to be provided for. Naturally enough, prices blew out of the chimney in this forced draft of demand. Three times the peace value was a fair price.

"I must have tents and blankets and cots for 250 men by six o'clock," was the telephone message that came to one buyer at noon one day.

"There isn't a tent nor a blanket nor a cot in town," said the buyer.

Usually that would have ended the conversation. But the man at the other end of the telephone was in earnest.

"Then 250 men will sleep in the snow tonight and cover themselves with a ditch," said he. "Don't tell me you can't get that stuff. You've got to get it."

NO ATTEMPT TO SAVE DOLLARS INSTEAD OF LIVES

He got the stuff, of course. That was General Pershing's standing order in those days. He did not attempt to save dollars at the cost of lives and worry and days. If he had tried to save money that way, he would not have been fit for his job. Little by little, order came out of the original chaos. The things that were needed before the army could set up shop in France—before it could even open the shop door—were bought at the best prices possible. Then began the work of organizing the business. The army began to plan ahead and cut out waste.

The Purchasing Board was created. It is composed of the purchasing officers of the various army departments, while the purchasing officers of the Y. M. C. A. and Red Cross have a sort of collateral relationship to the Board, for both organizations are often in the market for the things the army needs. At each meeting the purchasing officers pool their discoveries and their needs.

Scouts have ransacked France and England and neutral Europe for deposits of raw material. The list of needs is made up in each department for three months ahead.

"Seven departments want 40,000 fish-hooks each," it might read, it being understood that in verity no department wants fish-hooks. "There are 192,000 fish-hooks available at the following prices."

WORKING IN CONJUNCTION WITH THE FRENCH MILITARY MISSION

The need being imperative, the purchasing officers of the seven departments are given permission by the Board to buy the fish-hooks. But before the buying is done, the need and the prices are placed before the French Military Mission, which works in conjunction with the Purchasing Board. It is conceivable that the French army needs fish-hooks, or army shoes, or rubber blankets, or whatever the item may be. It has the first call on the material available, but its officers have shown themselves extraordinarily helpful and generous. They have always pruned their own wants to the final hair rather than pinch the Americans.

"I cannot say enough as to the spirit in which we have been met," said the chief purchasing officer. "The French have placed their entire organization at our disposal and have opened all their records. Far from asking them to do more, our constant feeling is that we are ungenerous in permitting them to do so much."

The French Mission also passes upon the prices the American officers are willing to pay. In some instances purchases have not been made because the price was exorbitant. Throughout all these deal-

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AN AMERICAN RAILWAY STATION NESTLED IN THE HILLS OF FRANCE

Every car that is put on wheels in France means a saving of precious tonnage over the ocean. Eight hundred castaway Belgian locomotives have been rescued from the junk yards by the American Purchasing Board and are now being rebuilt by Belgian workmen.

ings the spirit of mutual helpfulness is evident. Sometimes the French Mission has been able to secure better prices than the American officers have found, and sometimes they have revealed stocks of material the Americans had been unable to find. When the consent of the French Mission is obtained the purchase is made.

In the first days of the American expedition in France purchases were made in a scattering fashion. Then it became obvious that if only a few tents were needed at the moment, the day would come when tents by the thousand would be necessary. Therefore the man who found tents for sale—or anything else—bought all he could find if the price was right. Nowadays system has come into its own. The list of requirements for the army is made up now for three months ahead, on the basis of requisitions furnished by the officers commanding the active units. That is known as the "uniform" equipment. It is apparent that a unit of 25,000 men will always need certain things. It is equally apparent that there is no close relation between 25,000 railroad ties and 25,000 men. Sometimes the "exceptional" equipment comes into play.

RAILROADS PLAYING A MAJOR RÔLE

"We must build railroads," the Purchasing Board was told by headquarters. "Get the material."

In the good old days railroads were not of the major importance in warfare that they are today. The Germans upset the old rules of transportation. Early in the war they began to string little quarry roads behind the western front. The French followed suit. When the British began their Somme offensive, in 1916, they had laid more than 3,000 miles of road, standard and narrow gauge, behind their comparatively narrow front. The American army's railroad needs will also be great. The existing roads from the water bases must be reconstructed to take care of the heavy traffic anticipated. Preparations must be made for the feeder lines behind the front, when that front becomes an actuality.

The American army cannot take cars and engines and cross-ties from its allies. "Scout for them" was the order of the purchasing officer.

It is at this point that the American business men who have become officers in the American army began to show themselves particularly useful. The chief purchasing officer once said a pertinent thing: "Put a captain of industry," said he, "in a uniform of a captain of the army and you have a combination that gets results." These men are familiar with all phases of American and European business. They know where things may be found and how to find them and how to buy them. They are used to doing big things in a big way.

PREDICAMENTS OF SPAIN AND SWITZERLAND

So the scouting for railroad material was done by experts. Little jags of steel rails were found that had been forgotten. There were disused patches of railroads and sidings that furnished a handful each. Wanderers in the back blocks of Switzerland and Spain and Portugal found railroad ties. Portugal was ready enough to sell—at a price—for she is an ally, but at this point the Purchasing Board entered the realms of diplomacy. Switzerland and Spain were likewise willing to sell—but for a consideration over and above the purchase price.

These countries had an "internal" situation to consider. Señor Garcia Price, Prime Minister of Spain, in a recently quoted interview, declared that if the United States did not furnish cotton to the Barcelona mills hundreds of thousands of persons would be thrown out of work. A crisis cloud is forever banking up on the edge of the Spanish horizon. There has not been the least concealment of a revolutionary party in Spain, or that an enforced stoppage of work would naturally strengthen the forces of discontent.

In similar fashion Switzerland is set between a very ravenous devil and a particularly blue sea.

On the one side she must buy coal and iron ore from Germany, or her people would freeze in the winter and her industries would wither and blow away. Before Germany will deliver these and

other things that the Swiss must have, she extorts her own terms. Germany recently compelled certain Swiss banks, unofficially, to take a part of a war loan, for example, and the Swiss food reserves are continually tapped by her.

It would be impracticable for Switzerland to turn over to Germany the foods she receives from the Allies, but Swiss cheese is about the scarcest thing in Switzerland. The Allies appreciate the position in which Switzerland is placed and have tried to be as generous as possible. Most of her food-stuffs come from France and Great Britain today.

I am not in a position to go more deeply into the course of the diplomatic negotiations which the Purchasing Board entered upon. But the American railroads in France will be set in part upon 25,000 ties bought in Switzerland, while 20,000 sleek Spanish mules have braved their way across the mountains to enter Uncle Sam's service. Contracts have been let to Swiss manufacturers to make certain things for the Americans, too, and there a further dalliance with diplomacy was needed.

The raw material must be furnished the Swiss, for they did not have it. That was agreed to. Then Germany became aware of the arrangement. Germany furnishes a greater part of the coal to Switzerland. The mere suggestion that an ounce of her coal should be used to fire boilers to make steam to run lathes to shape shells—or other things—for the wholly to be looked-down-upon Americans sent the Wilhelmstrasse into a tremble. So the Purchasing Board had to arrange that coal should be furnished these manufacturers.

RAILROAD CARS LOST AND FOUND

Railroad cars were found here and there. One would not think that so conspicuous an article as a railroad car could be lost, but they have assuredly been found. The explanation is that France has had no men to spare for repairing cars, except when the repairs were vitally necessary. Little by little, derelicts have been cast away in railroad backwaters. They still had the outward aspect of cars, and there were wheels under them, but that was about all that could be said. The American scouts, prying into all stray corners, found them, and workmen were found—some of them belong to American engineer regiments—and the cars were made over again. Every car that could be put on wheels in France meant a saving of precious tonnage over the ocean. Then a discovery that might be called sensational was reported to the Board.

"Did you know," a scout asked, "that there are 800 unused Belgian locomotives in France?"

ALL THAT WAS LEFT OF BELGIUM

The tale of the locomotives is a tag to the tragic story of Belgium. When the Germans invaded that little State, the dazed people saved what they could. Most of the rolling stock was lost, but the Belgians managed to run 1,900 engines over the border into the safe land of France. The needs of France and England were paramount in those days, and 1,100 engines were turned over to the armies for service. Naturally enough, only the best were taken. The 800 that were left were rusted and shabby, but they were precious in the eyes of their Belgian owners.

"They are all we have left," they said, "all that is left to us of Belgium."

Once more the purchasing officer became a diplomat. The Belgians had been ruled by sentiment. For the moment they were not thinking of the practical side of the question. The 800 old engines were a symbol in their eyes. They were useless as they were. Weeds were growing through their fire-boxes. Many had been sacked of spare parts that better engines might be rebuilt. They were incredibly and pathetically decrepit, but they were all that was left of Belgium.

"We're trying to help you, you know," said the purchasing officer. "Let's all pull together."

So he got the engines. Before they could be made useful they must be rebuilt. Belgian workmen were available for the rebuilding, and there are no better workmen in Europe; but they were empty-handed. The Purchasing Board's scouts patiently ransacked France and

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ISSUING SUPPLIES TO TROOPS IN FRANCE

"The American army is 3,000 water miles away from its home base, in a country that is increasingly feeling the strain of more than three years of war"

England, hole and corner, until enough machine tools were found for the operation. France was practically cleaned of her spare machine tools, but somewhere in France the rebuilding process will be finished by the time the Belgian locomotives are finished.

In England the Board's scouts work with the government. Manufacturing is the great business of the country. The British are familiar with it. Early in the war they took steps to earmark all stocks of raw material, so that when the Board wants a given thing it has but to say so.

The permanent under-secretary, in charge of three-inch screws, has but to turn to his index to state whether he can furnish the screws wanted and when and how many and where. It is different in France. The French are individual to their heels. Instead of one large manufactory, they prefer many small manufactories for a given output. Each factory stands on its own bottom. Each has its own supplies.

Further, France has been so busy fighting since the beginning of the war that she has not had time to take governmental charge of her deposits of raw material. Her administrative energies have been devoted to getting every valid man in line and keeping him there. Coincidentally, her manufacturers have been able to keep that line nourished with every form of supply an army needs, but it has been largely by private enterprise.

The individual manufacturer has found his materials where he could and the women have done the work. It is the women who will do the work when the American Army's Purchasing Board goes into the manufacturing business this year.

ARMY'S BUSINESS OPERATIONS FIGURED IN TONNAGE

Every business operation of the army is figured in tonnage terms nowadays. The great question is how the tons can be saved. Almost as soon as the Amer-

icans reached France the camp buckets and kettles and pots and pans were identified by some observer as space-wasters in shipholds. Pots that will "stack" were bearable, but too many kettles will not stack. So the tin and galvanized iron and what-not needed were brought over in the raw and contracts given to any small workshop factories in France to manufacture these minor and clangorous items. The idea proved sound. France is short of labor, but there are still women and youngsters and exempts to be had. The Purchasing Board began to ask itself:

"Why not make more things?"

Canned goods are a staple of the American soldier's dietary. He likes to buy a can of peaches and a can of condensed cream and pour the milk onto the peaches and fragrantly eat the combination. All his life he has been used to canned goods. Every company canteen has handled "airtights." But they take up a frightful lot of space on shipboard, and besides there is plenty of fruit to be had in France. To bring American canned goods to a country where each peasant makes a pet of a pear tree is like carrying coals to Newcastle.

FRENCH WOMEN TO CAN FOR AMERICAN SOLDIERS

So the tin is to be brought over in sheets and made into cans in French shops. Next summer the farm women of France will be supplied with tin cans and sugar and contracts, and will furnish what part of the canned goods for the American army's consumption that may be possible. The French woman is particularly expert at jam-making, and next winter the American boys will have jam on their white bread. There is an annex to this story, too. For some reason France has never taken kindly to canning fruit, although, oddly enough, quantities of American canned fruits have been sold in France. It is believed this practical demonstration on a large scale may mean the creation of a new industry.

If I tell the story of another of the Board's infinite number of manufacturing activities, it is only because it even better illustrates the care that is being taken to cut down tonnage. Chocolate is a standard item with every soldier. When possible, chocolate candy is put on sale in the canteens, and when that is not practicable chocolate bars are offered him. Cocoa beans, however, do not originate in the United States, and there is a demonstrable waste of time and space in shipping them first to America and then combining their essential oils with sugar and sending the resultant goody to France; so that now the cocoa beans are shipped straight to France from the place of origin and the sugar sent over from the United States. French manufacturers do the rest. Likewise the sweet, crisp biscuits the boys like are no longer being imported. The sugar and flour are brought in and turned over to French bakers.

American splints are being made in France on the same plan. In pursuance of the army policy of getting ready for the worst, an enormous supply of splints was considered necessary. Splints are awkward things to pack. They come in queer, unusual forms, and must be carefully boxed, because they are very fragile. After the standard forms had been decided on by the Army Splint Board, which is in charge of this item, the order was turned over to the Red Cross, which had promised to supply them. Acting in perfect harmony with the Purchasing Board, 100 tons of the needed metal were brought to France and the splints were made. They would have taken up not less than 1,000 tons of shipboard space if shipped in the completed form.

MEN WHOSE HEARTS ARE IN THEIR WORK

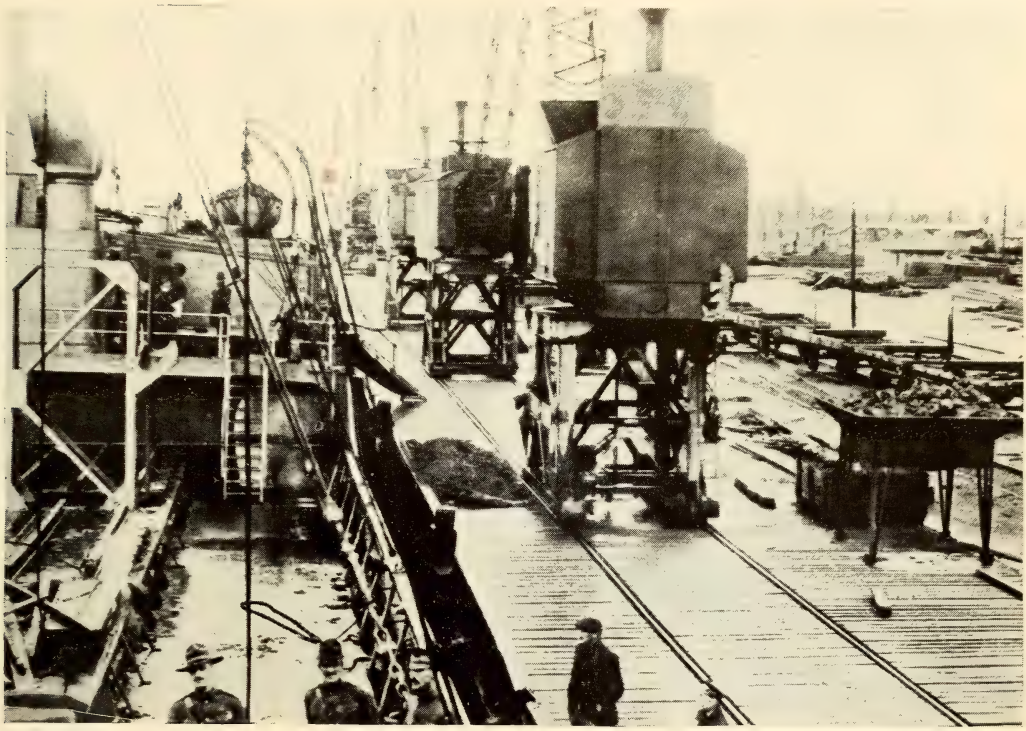
When an army requisition has passed through the Purchasing Board's hands, the terms of the equation are about as follows:

"We need so many tons;

"We can buy so many tons in France;

"We can import so many tons."

Then general headquarters passes on the order. General headquarters is the final arbiter on all things. Somewhere in that mysterious region is a sheet showing the number of ships which are to sail from the United States and the tonnage space available. There is always a need for a great deal more space than can pos-



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STEAM CRANES USED IN UNLOADING AMERICAN SUPPLY SHIPS AT A FRENCH PORT

The American army's Purchasing Board in France makes purchases, negotiates with European labor, adjusts American machines and ways of doing things to continental men and women—all to relieve allied shipping and French docks of as much of the transportation burdens as possible.

sibly be secured, so that general headquarters goes over the list of needs with a pruning knife. It is interesting—and tragic—to listen to the men whose departments have been pruned. They act as if their entire future lives had been spoiled. They are the sort of men General Pershing has on this sort of a job. Their hearts are in their work.

Once the wants are compressed to the dimensions of the can-gets, the orders are sent to the United States for the material that is to be shipped. On the French side the General Purchasing Board, through its members, is hurrying about, getting what can be got. The Board, as a Board, makes no purchases. It is only a directing mechanism—a sort of a congress of prices and supplies. The competition between the different departments of the United States Army has been disposed of in the session of the Board in which each man has placed his cards upon the table; but there is still the competition with the French and British governments to be guarded against.

This guard is absolute, where goods are to be bought in Great Britain. There the British Government does the buying and the United States Army settles for the goods bought; otherwise no goods could get out of England. Not even a Christmas card could be sent to France last winter without a special license for the sending. In the neutral countries of Europe a Franco-American Purchasing Board handles all such purchases, except in cases where the Inter-Allied Purchasing Board assumes the right.

It is too early as yet to say what will be the full scope of the Board's manufacturing activities in France. However, apart from the question of raw material, it must be limited by the labor and facili-

ties available. The greater part of the present manufacturing potentialities of France are already absorbed by the needs of the government and the civilian population. It would be a comparatively easy matter to enlarge the factories now in being, or build more, and equip them with American machinery, but the labor is not at hand.

"WHY NOT IMPORT AMERICAN LABOR?"

"Why not import Americans?" I asked.

That has been carefully considered, it appears, but the idea is not likely to be put in effect on a large scale. Every imported American must be fed and clothed and provided for in France. Use will be made of all the labor available on the ground before the Americans will be brought over. The Purchasing Board once had under consideration bringing in labor from Greece and Spain, but diplomatic considerations intervened. This is a story that may never be told.

Offhand one would think that many of the things now being bought would outlast the war. But things do not last in war. Clothing wears out and tents go to pieces and mules die and cars get shell-shock. The chief purchasing officer thought that the 1,804,000 tons which were purchased in Europe in six months (the total must run to more than 2,000,000 by the time this article appears) would prove to be only a beginning. As the army increases in France, so will the purchases. The time will come, of course, when the buying will be largely confined to the raw materials available, but that buying will account for practically every pound the armies of the other allies do not take.

To the outsider the impressive feature of the organization, apart from the dent that is being put in the U-boat totals by this organized and systematic development of assets at hand, is the perfect teamwork that prevails. Some members of the purchasing department are Regular Army officers; others are business men who have never seen an army officer before except in the Memorial Day parade. Their methods and training and outlook are entirely different; yet they have dovetailed together perfectly.

The complexity of their tasks may be surmised from the fact that the first two requisitions passed on totaled up more than 3,000 articles, but competition between departments and governments on prices had been practically eliminated. These men have been suddenly called upon to handle a business ten times as large as that of United States Steel, and they have handled it. Some have made good and some have failed; but most have made good.

The chief purchasing officer remarked, incidentally, that in his six months at the job he had not found one case of dishonesty on the part of an army officer; but he did not think that remarkable.

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THE NATIONAL GEOGRAPHIC MAGAZINE

THE HEALTH AND MORALE OF AMERICA'S CITIZEN ARMY*

Personal Observations of Conditions in Our Soldier Cities by a Former Commander-in-Chief of the United States Army and Navy

BY WILLIAM HOWARD TAFT

EARLY last winter disquieting reports gained circulation concerning the conditions in our National Army cantonments and with regard to the morale of the drafted men.

According to these reports, a large percentage of the men would be glad to leave their camps and return to their homes. It was said that they did not understand the issues of the war; that they did not think it necessary to send an army to France.

Dr. John R. Mott, the General Secretary of the Young Men's Christian Association of the United States, and one of the great men of this generation, sent word to me of these reports, received from agents of the Association detailed for work among the drafted men.

While there was neither sedition nor mutiny among the men, Dr. Mott deemed it of the highest importance that some one should go to them to explain why we were in the war, why an army should be sent to France, and why it was necessary to fight this war through as a battle for Christian civilization.

He said there were sixteen cantonments, one of which, Camp Lewis, at American Lake, on the Pacific coast, I could not reach, but the other fifteen he asked me to visit and to speak at length on the subject, twice a day, to the soldiers in each camp. Subsequently, Camp Dix, at Wrightstown, N. J., was excluded from my list because of a quarantine, and there were substituted Camp Sheridan, a National Guard camp, at Montgomery, Ala., presumably because it was the Ohio National Guard, and the naval cantonment at the Great Lakes, north of Chicago, where 25,000 men were in the course of preparation for the navy.

I doubted my power to attract the attention of the drafted men to the issues and to convince them, but I felt it my duty to go, if men like Dr. Mott and Mr. William Sloane, the president of the army branch of the Young Men's Christian Association, thought it would be helpful, as they said they did.

Accordingly, on New Year's Day I visited Camp Grant, at Rockford, Ill., and spoke four times there to audiences of 3,500 men each. Thence I went to Camp Dodge, near Des Moines, Iowa, and spoke there to similar audiences five times.

* Lecture delivered before the National Geographic Society, in Washington, D. C., March 15, 1918.

THE BOND BETWEEN THE BOY AND HIS HOME IS EVER PRESENT: INTERIOR OF A Y. M. C. A. BUILDING AT FORT SNELLING, MINNESOTA

THE EXTENT OF THE TOUR

On January 24 I began a tour of the camps, including Camp Devens, Ayer, Mass.; Camp Lee, Petersburg, Va.; Camp Meade, near Baltimore; Camp Jackson, Columbia, S. C.; Camp Gordon, Atlanta, Ga.; Camp Sheridan, Montgomery, Ala.; Camp Travis, San Antonio, Tex.; Camp Pike, Little Rock, Ark.; Camp Funston, near Junction City, Kans.; Camp Taylor, Louisville, Ky.; Camp Sherman, Chillicothe, Ohio, and Camp Custer, Battle Creek, Mich.

I finished the tour at the Great Lakes Naval Training Station, near Chicago, on February 20, having made in all fifty speeches, at least an hour in length and sometimes longer.

In some instances the attendance was voluntary; in others there was a regular detail, but in all cases the men at one meeting were excluded from attendance at another.

This may seem to many who read it that it was cruel and unusual punishment and added a burden to the draft. However, on the whole, the boys stood it fairly well and listened with apparent interest and responsive attention.

In the course of my address I tried, by illustrations and stories in a lighter vein, to escape the somnolence that an argument on legal topics often produces, and I hope I succeeded in giving the boys more than one "seventh inning" in which to relax their mental muscles and take a rest.

What I attempted to do in these addresses was to argue out the case of the United States against Germany; to show that she forced us into the war by a violation of our national rights in attempting to fence off a part of the high seas against our commerce, and in murdering 200 of our citizens by sinking them on commercial ships within the zone without warning, and threatening to continue this course in the future. It involved a reference to the principles of international law and to a demonstration, by precedent, of the rule which required a belligerent, in destroying a commercial

RELAXATION OF MIND IS AS NECESSARY AS GOOD FOOD

ship of its enemy or of a neutral on the high seas, to secure the safety of the ship's company of the destroyed vessel. I pointed out that Germany left no course to a government of honor, which professed to defend the rights of its citizens to life against murderous invasion, to do other than to declare war.

THE CASE OF THE WORLD AGAINST GERMANY

The second part of the argument was devoted to presenting the case of the world against Germany, and involved a tracing of the history of the German people from the time when they were 28 divided States, in the nineteenth century, to recent periods, when, through the education of Bismarck and the Prussian military régime, the people, following the law of William and the Potsdam gang, had become obsessed with the conviction that they were supermen in war and in peace, and were charged with what they called a divine destiny, and which was nothing but a lust for world power, in spreading German kultur over the world; and I attempted to enforce as strongly as possible the view that, having abolished in her rules of national living international morality, Germany, under her present leadership, was a perpetual threat to the integrity of every nation, and especially of democracies, and made a permanent peace impossible; that we must bring Germany to her knees by defeating her, which would necessarily turn the people against their leaders and their former false ideals and make them an amenable member of the family of nations; that if we made an inconclusive peace with her, only two alternatives were open to us: One was that of submission to the suzerainty of Germany; the other was the maintenance of our nation as an armed camp to resist German aggression in the future, with a certain prospect of another war with Germany as soon as opportunity seemed to her at hand.

I tried to make my statement of international law and the course of the argument as simple as I could, and if I can trust the expressed judgment of others and separate it from the promptings of

Photograph by U. S. Navy Department

SEMAPHORE AND WIG-WAG SIGNALING: NAVAL TRAINING STATION, NEWPORT, RHODE ISLAND

When a young American undertakes the patriotic job of becoming a fighting sailor, one of the first things he has to master at a naval training station is his "A, B, C's," for he must learn to read, not the printed or written page a few inches from his eyes, but the wig-wag writing of a fellow-seaman hundreds or even thousands of feet away. The radio and the wireless telephone have accomplished marvels in facilitating communication between the units of a fleet, but the semaphore and the wig-wag flag still have their place in the service.

kindly courtesy, I think it helped the boys by fixing in their minds at least the logical and chronological sequence of events and in bringing home to them the vital concern we have in the issue of this war.

THE NECESSITY FOR PROPAGANDA

This war differs from other wars that we have been in, in the necessity for propaganda to explain its issues and its profound importance to the people of the United States. When it came on, in August, 1914, the whole people rejoiced that we were so remote from the seat of war, separated by the Atlantic Ocean, and so barred from it by our national traditions that we would escape the vortex of destruction and suffering that was opening to the European nations.

For three years we occupied as near a judicial position as the circumstances permitted and discussed the issues between the nations with an impartial state of mind. Then we were forced into war through a violation of our rights at sea. It was difficult to arouse our people to the importance of those rights in a zone of the high seas so far away as Great Britain and Ireland.

The statements of the President properly set forth as our object in the war certain ideals of a world character and importance. Our material interest in maintaining those ideals, however, it was difficult for the people to appreciate.

The issue was not as it was in our Revolutionary War, at our doors, and had not been the subject of political discussion for half a century, as the slavery and secession issue had been before our Civil War. Prosperity and money-making, high wages and high profits, absorbed the interest of our people, and it was difficult to challenge their attention to the inevitable consequence of German victory. Hence the con-

sciousness of the fact that we are really in war has but slowly been stealing over our people as a psychological fact.

The officers in command of the cantonments which I visited were general officers of the Regular Army. I had met them and known them all in the Philippines and in the War Office. They now wore stars instead of the captains' bars or majors' leaves which they wore in Philippine days. They talked freely with me about conditions, and with the information which they gave me and that which I derived from the numerous Y. M. C. A. secretaries, I feel that I obtained fairly reliable information as to conditions prevailing in the camps. I soon became satisfied that the attitude of the men toward the war and their service in it, as reported to Dr. Mott, which had induced him to ask me to make the trip, had radically changed. It must have been that his informants had sent word to him at a time before the men had become adjusted to their camp life.

THE FINEST MATERIAL IN THE WORLD FOR THE MAKING OF AN ARMY

The men when drafted were from 21 to 31; many of them had become more or less settled in life. Many of them were in receipt of compensation substantially greater than that which they would receive as private soldiers. The inconvenience and lack of comforts inseparable from a camp life they had not grown used to, and they naturally were at first in a state of protest and question over the change. When I went through the camps, however, they had grown accustomed to camp life. In the drill and manual training and instruction they had begun to understand the government's purpose and had become interested in fitting themselves for their new duties.

The commanders of the camps assured me that the drafted men were the finest material for the making of an army they had ever seen in any country. On the average they were better men physically, mentally, and morally than the average of the National Guard or of the Regular Army. They were a clean slate to write upon. They did not have to unlearn anything and they learned quickly. They manifested the known adaptability of the American. The difference between their appearance when they first reached camp and after three and four months' training was wonderful. Their appearance in review, as they went by with their lithe figures, their martial bearing, their military step, their bright, healthful color, gave one a thrill of patriotic pride. Their response, as they sat in a great audience, to patriotic sentiment showed that their hearts were in the right place. They are an object-lesson in universal military training and a powerful argument for its establishment.

EVERY SOLDIER MUST BE AN EXPERT

The German has so changed the art of war that every private soldier must learn his trade as an expert. Through discipline and practice he must acquire a knowledge of the particular duty assigned to him, so as to make his performance of his proper function second nature. This is being impressed upon them by their own officers and by the English and French officers, of whom there are eight to ten in every camp.

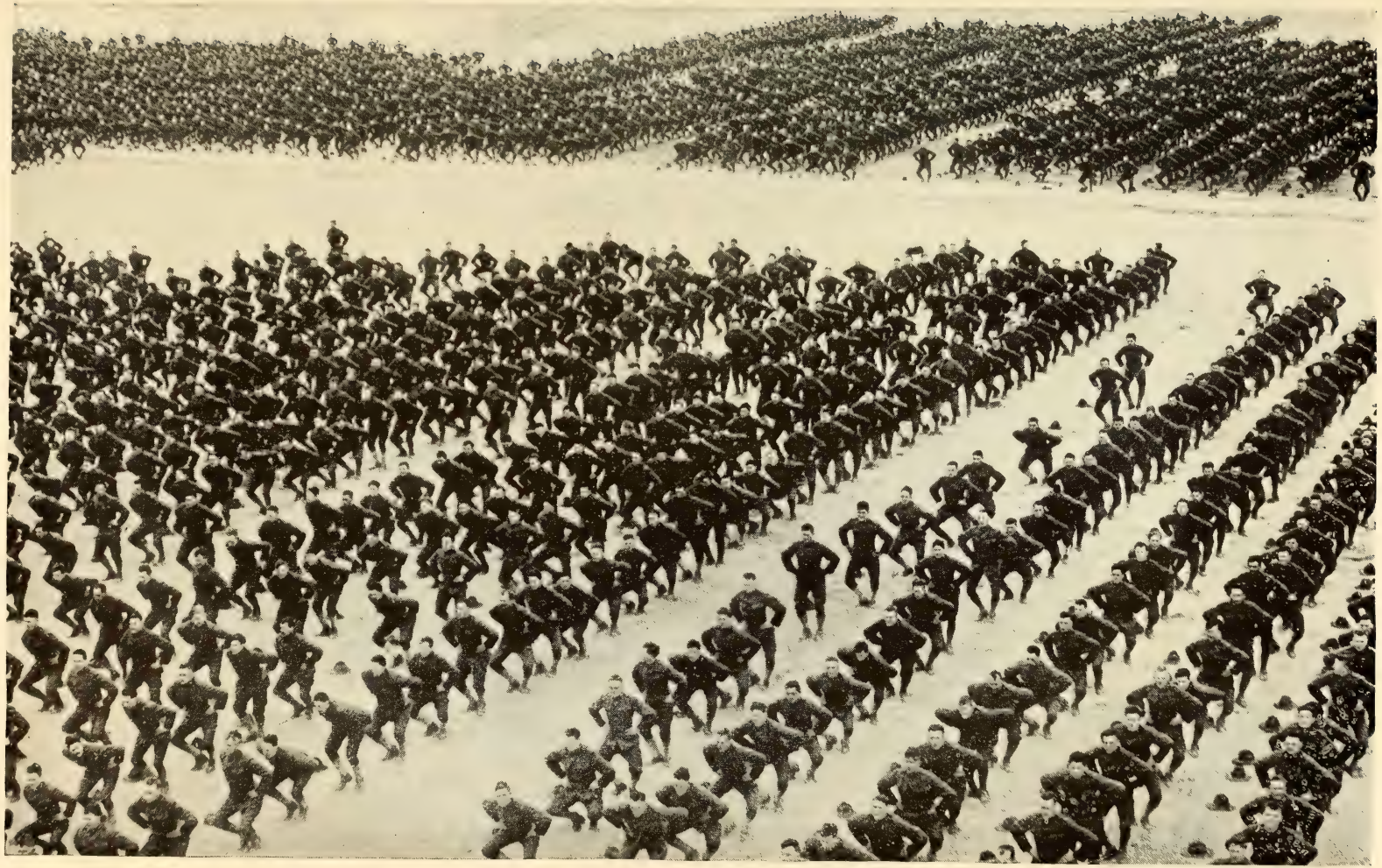
I ventured to point out in every speech I made the importance of discipline and practice and included a word on the necessity for the salute. The salute is said to be descended from the salute which one knight made to another in the days of chivalry by lifting his visor. It is only a recognition by one member of the craft of his association with another of the same craft. It does not involve inferiority or servility. The private salutes the officer. The officer is one of higher rank. The salute must be returned. The duty of initiating the ceremony is a recognition of subordination, a relation that must exist in an army if an army is to be an effective military machine and not a mob.

The progress in military science has been in the development of the machine-like operation of the different parts of an army. The private soldiers are cogs working into other parts of the machine and moving under control of their immediate and higher commanders, as cogs act with the wheels and other mechanism with which they coördinate. The salute is only a recognition of this relation of association. It was interesting to watch how the new men disregarded it and how

Photograph by Earle Harrison

INTENSIVE TRAINING

A three-inch gun in action under a camouflage of straw and sage-grass. First Virginia Field Artillery in training at Chickamauga.



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SETTING-UP EXERCISES: 10,000 MEN IN TRAINING AT CAMP HANCOCK

"The commanders of the camps assured me that the drafted men were the finest material for the making of an army they had ever seen in any country"

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A CORNER IN CORRESPONDENCE AT A SOLDIER CITY POST-OFFICE

Letters from home are vital factors in maintaining and elevating the morale of the men in camp. The student soldier works better and learns to fight harder when encouraged and heartened by words of cheer from those whose service to democracy lies in civilian fields of activity.

the men with more training gave great attention to giving it properly.

EXPLAINING THE NECESSITY OF THE SALUTE

I sought to win the sympathy and confidence of the boys by reference to the fact that my own son is an enlisted man in the field artillery. I think it enforced my argument in favor of the necessity of the salute, by pointing out that I would not be likely to approve it if it was any evidence of his inferiority or servility.

The freedom and independence that an American youth enjoys make it necessary to have the reason for such a ceremony explained to him. His self-confidence and his self-conceit make it irksome to him, at first, thus to register his subordinate position or to obey implicitly, as he must, if he would be a good soldier. His love of initiative and his intuitive lack of discipline make it hard for him to conform to the rigid requirements of military life, but after he has acquired the habit, then his initiative, his willingness to assume responsibility, his intelligence, and his independence add greatly to his effectiveness as a soldier.

It is these traits, under proper discipline, that are now making our brigade and division commanders so proud of their drafted men.

Next in importance to the control and influence exercised by their commanders is the environment and opportunities for occupying their leisure which the Young Men's Christian Association affords to the men of these cantonments. In a division there are frequently as many as 50 Y. M. C. A. secretaries. They are dressed in a neat khaki uniform, with a red triangle on their arms, and they live a life of soldierly routine. There is the principal headquarters of the Association in each camp and one great auditorium,

© American Press Association

A FIELD BAKERY AT A NATIONAL GUARD MOBILIZATION CAMP

"Too many cooks" may spoil the broth in civil life, but it takes 32 bakers to produce the bread supply for one encampment. The capacity of a cantonment bakery is nearly 40,000 two-pound loaves every 24 hours of operation. At the National Guard camps, of course, the requirements are smaller.

which will hold 3,500 men. The seats in it are movable, so that the hall may be used as a gymnasium and for basket ball. At the headquarters and in the 12 or more Y. M. C. A. branch houses, one to a brigade or less, are local opportunities for reading and writing and all sorts of entertainment.

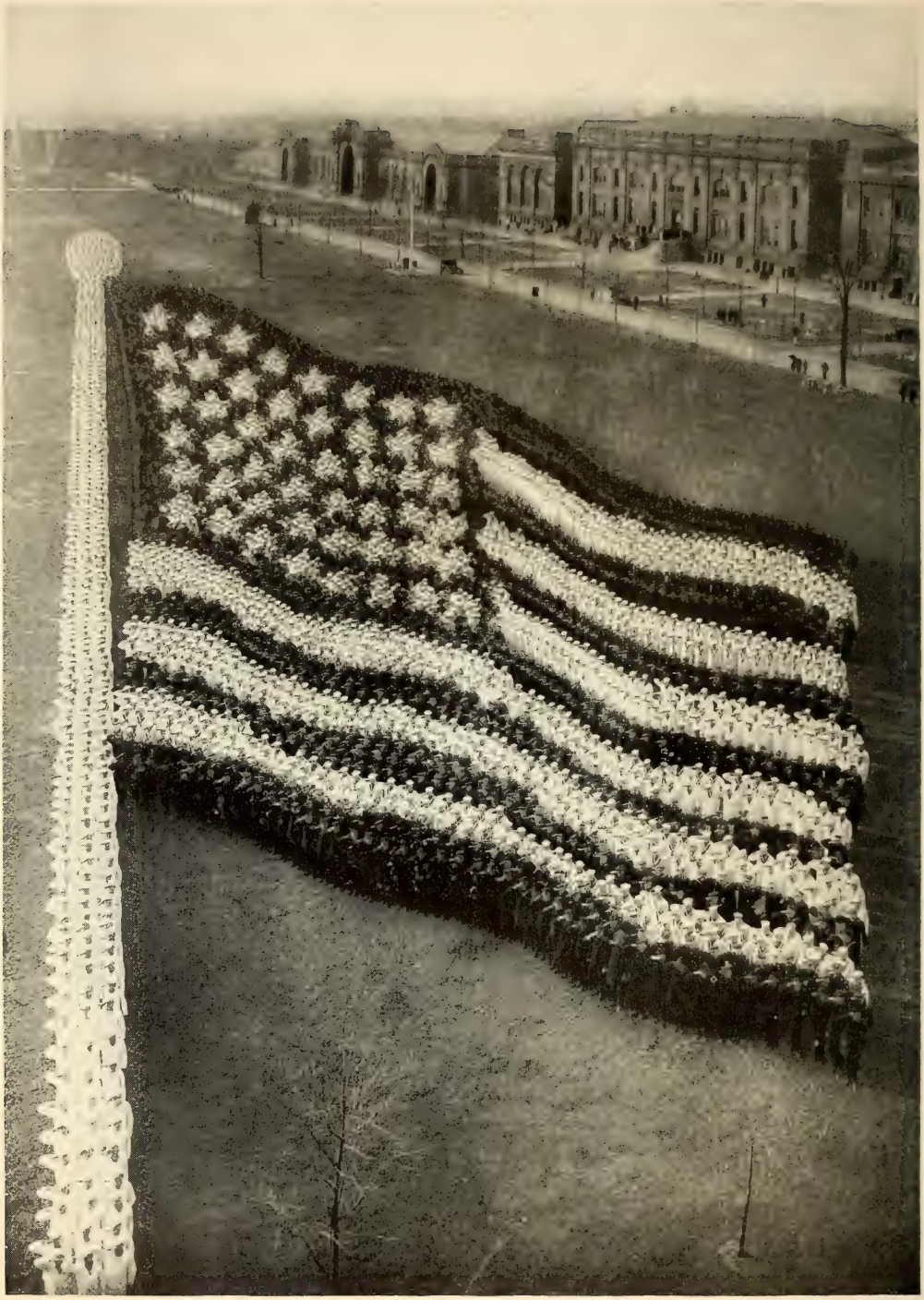
The Knights of Columbus have one auditorium nearly as large as the large auditorium of the Young Men's Christian Association, and a very comfortable place it is. There they hold the principal religious masses of the week.

Where there are agents of the Young Men's Hebrew Association, they are received by the Young Men's Christian Association and furnished an opportunity to help their Hebrew brethren.

Nothing is more gratifying than the complete coöperation among these three institutions of differing denominational origin. It often happens that as the camp is very large, the Catholic priests ask to use a local Y. M. C. A. branch for a mass for the regiment near which the branch auditorium stands, and the request is always granted. In every way there is a brotherhood spirit between the organizations which prevents duplication and makes for effectiveness.

NO SOLDIERS' CAMPS EVER BEFORE SO FREE FROM DRUNKENNESS

In some of the camps there is a large so-called Liberty theater, erected by the Fosdick Outside Activities Association. The theaters are well constructed and make good auditoriums, and here vaudeville reigns. It is not too much to say, however, that the agency upon which the commanding generals lean in dealing with the social side of their men and in filling their leisure hours with useful occupation and entertainment is the Young Men's Christian Association. Its organization



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THE GREATEST FLAG IN THE WORLD: 10,000 BLUEJACKETS FORMING A LIVING EMBLEM OF THE AMERICAN UNION

This animated Stars and Stripes, formed at the Great Lakes Naval Training Station, covered an area of seven acres. The ball was composed of 250 men; the pole (not including the ball) was 550 feet long, four feet in width at the bottom, six feet at the top, and required 700 men; 1,600 men were required for the white stripes; 1,900 for the red, 1,800 for the stars, and 3,400 for the blue field. In order that the proportions should appear correct, many niceties of perspective had to be solved. For example, the topmost star was composed of 65 men, in order that it might appear the same size as the star nearest the camera's eye, with only 12 men.

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A HOSTESS HOUSE FOR BOYS IN TRAINING AT ONE OF OUR SOLDIER CITIES

Among the most effective social undertakings of the Young Women's Christian Association has been an arrangement whereby homes in the cities adjacent to the cantonments are thrown open to the men in uniform. Here they may enjoy that social intercourse of which they were suddenly deprived when they responded to the nation's call to arms.

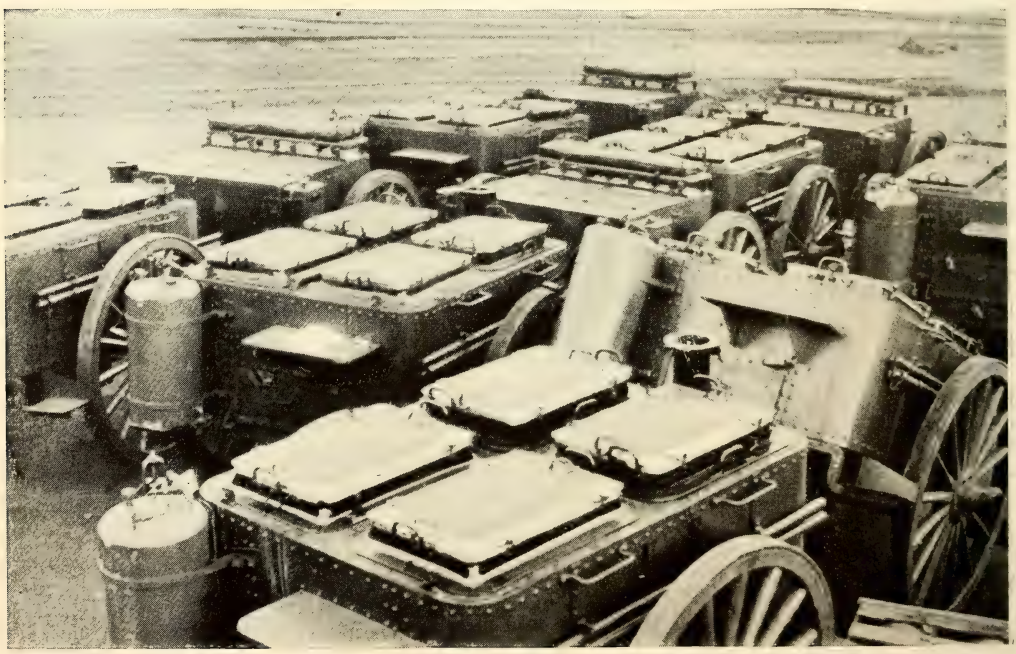
Photograph from Burnell Poole

THE CHAMPION RACING CREW OF THE ATLANTIC FLEET

At the Great Lakes Naval Training Station, near Chicago, the navy is training 25,000 youths, most of them between the ages of 18 and 22. During the past winter they received instruction in two great drill halls, one of which is capable of accommodating 7,000 jackies.

AN AMERICAN OBSERVER AT HIS LOOKOUT POST

Instruction for the Intelligence Corps is a highly specialized course, and a school where this is taught is located at one of our cantonments. The observer shown in the illustration is a student at this school and is watching from his place of concealment the effect of his battery's artillery fire upon the enemy.



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A KITCHEN BATTERY

Plenty of good food at the right time is one of the chief problems with which an army head must contend, and by means of these efficient ranges our soldiers can be fed along the line of march.

is so large and so complete and so effective that it enters into every soldier's life. Of course, on the other side, when we have casualties and many wounded, the functions of the Red Cross will assume the greater importance; but in the training camps it is otherwise.

It is most gratifying to be able to testify, from all the information I could get, that no camps have ever been so free from drunkenness as those in this present national effort. In most cases the nearest towns are dry, and the great cities where drink may be had are so far from the camps as not to prove a temptation. The same thing is true of the morality of the men, so far as I was able to learn from the commanding officers. There were some of the camps where the neighboring towns were wet, but the danger of selling liquor to soldiers as a violation of the commercial law has proved a very excellent preventive. I must think from what I saw that the activities of the Y. M. C. A. and these other institutions have played a large part in maintaining decent and proper living among the soldiers.

The sites of the camps seem to have been very well selected, so far as drainage and water supply were concerned. The sanitary features have been well looked after. In some, as at Columbia, S. C., the soil is so porous that a drill can be held without difficulty the same day after a heavy rain.

EACH CAMP A GREAT CITY

Each camp is a great city of from 1,400 to 2,000 buildings, sufficient to house and accommodate 40,000 men. The distance from one end of a camp to another is often three or four miles, and from one side of a camp to the other some two or three miles. There is always in the reservation a place for a rifle range, though it has not always been constructed, and in a number of camps there is room enough for an artillery range, though the field guns as yet are few and far between.

The appearance of the camps is interesting, but not beautiful. The buildings are unpainted and the sites have frequently had to be cleared of timber, leaving stumps that don't add to the beauty of the landscape. I observe that the Quartermaster's Department has asked for $2,800,000 to paint the buildings inside and out, and I think it would be a saving of money to the government if this could be done. Certainly it would greatly add to appearance. The Young Men's Christian Association does paint its buildings green, and one's eye rests with relief upon them in these oceans of weather-stained yellow boarding.

The camps differ much in the roads constructed within their limits. In many of them within the reservation the main roads are good, but in muddy weather in some of the camps they are not what they should be. It would doubtless have been better if the roads could have been built before the buildings had been constructed, because the weather would then have been good for the building of roads, and it would have made the cost of transportation necessary in construction very much more reasonable. The roads from the nearest towns or cities to the camps also differ much, and some of them in the winter and in wet weather try cruelly the springs of the automobiles and the nerves of their occupants in going to and from camp.

THE MEN ARE COMFORTABLY HOUSED

The men in barracks are very comfortably housed. There are two methods of heating—one by great furnace stoves and the other by steam pipes. In the hurry of the job, and because of the difficulty of getting sufficient pipe, the system is not circulatory and wastes hot water at one end. This should be changed, and the quartermaster has recommended it, so as to make it a double system, which would be a great saving in the matter of water. It would probably offer a better opportunity for regulation. The criticism that can be made on the system now is, because it must be turned on or off from outside the building, it either parboils one or leaves one frozen in cold weather.

With some actual experience, I got the impression that the men on the whole are comparatively more comfortable than are the officers. There was in the beginning, it seems to me, an unnecessary disposition on the part of the officers to deny themselves comforts that they might just as well have had without any great amount of additional expense. Often, in-

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RECONNOISSANCE TRAINING

"See all; know all" is easier said than done. Without training, men see many things which they do not know that they see. Military observers must realize the significance of whatever comes within their field of vision. To this end these Signal Corps men are testing their observation powers on their own cantonment and telephoning their findings back to headquarters.

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IN CAMP EVERY MAN WHO CAN SING CHEERFULLY DOES HIS BIT

War songs are the order of the hour, and during the recreation period every piano is a lodestone attracting our soldiers-in-the-making

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THE SPIRIT OF CAMP CAN BE READ IN THE SMILE

Students of the ground school of aviation at Princeton enjoying the evening hour of recreation after a strenuous day

Photograph from M. Rosenfeld

HUNTING THE HUN IN THE BLUE ATLANTIC

The speed cruiser, making as high as 35 knots an hour and mounting rapid firers and depth bombs, is an effective means of combatting the "tin devil-fish" of Prussia, and abroad they have accounted for no small number of these marine monsters appearing within their cruising radius.

© Committee on Public Information

HARDENING AMERICAN MUSCLES FOR THE BIG STRIVE

Former President Taft believes that 5,000,000 of these stalwarts may be needed to win the war

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RANGE-FINDING INSTRUCTION

The distance from the field-gun to the selected objective must be quickly and accurately found—oftentimes under fire. This class of non-commissioned officers is being instructed in the intricacies of a newly adopted range-finder, which properly adjusted gives the required information at once. The gunner is given the range, the gun roars, and an observer watching through his field-glass sees a German battery go up in smoke.

deed, the haste with which conveniences were arranged indicated that no planning had been given from the standpoint of comfort. Certainly a woman would not have arranged the rooms and furniture and conveniences as they are now arranged at headquarters.

Nothing in the construction, however, has affected detrimentally the health of the soldiers. Very little of the illness can fairly be attributed to insufficient clothing, because while overcoats may have been lacking, they had sweaters and undercoats that kept the men generally warm.

THE HEALTH OF THE ARMY

Another error probably made in the construction of the camps was the failure to build the hospitals first; but in every cantonment, when I visited it, was a large base hospital, admirably equipped and amply able to take care of all who were likely to be ill in a full division, except under most extraordinary circumstances. The truth is that on the whole, considering the very great severity of the winter, which could not have been anticipated, the health of the troops in the cantonments has been excellent.

I wrote to General Gorgas, the Surgeon General, and asked him to send me the health statistics concerning the army. I received from him the following letter and table:

War Department,
Office of the Surgeon General,
Washington, *February 20*, 1918.

Hon. William Howard Taft, New Haven, Connecticut.

Dear Mr. Taft: Yours of February 15 is acknowledged. The data which you request concerning health statistics are inclosed. I am very glad to furnish them. As you go around to the various camps I would like to have you, where you have time, to take a look into the hospitals. The picture that the country has in general now with regard to all hospitals is unfavorable, and I am very desirous of having the people know the true picture, and particularly I would like to have you get the true picture. Such a picture can best be acquired by your seeing the hospitals in their actual working condition.

With kindest regards and best wishes, I remain,

Yours very sincerely,

W. C. Gorgas,
Surgeon General, U. S. Army.

What strikes me most about these statistics is that we have done better in death rate than did the Japanese, who heretofore have been looked upon as the most successful military sanitarians.

Annual Death Rate per 1,000, Regular Troops in the United States

	1898	1899	1900	1901
All causes	20.14	7.89	7.78	6.90
Diseases only	17.45	6.56	4.83	4.68

Troops in the United States September 21, 1917, to February 8, 1918

	All troops	Regulars	National Guard	National Army
All causes	8.7	6.1	9.9	9.1
Diseases only	8.1	5.2	9.4	8.7

Average strength, Regular Army, September 21, 1917, to February 8, 1918	244,833
Number of deaths, Regular Army, same period—all causes	610
Number of deaths, Regular Army, same period—disease only	520
Average strength, National Army, September 21, 1917, to February 8, 1918	422,039
Number of deaths, National Army, same period—all causes	1,561
Number of deaths, National Army, same period—disease only	1,496
Average strength, National Guard, September 21, 1917, to February 8, 1918	375,427
Number of deaths, National Guard, same period—all causes	1,515
Number of deaths, National Guard, same period—disease only	1,430
Average strength, all troops, September 21, 1917, to February 8, 1918	1,042,299
Total number of deaths, same period—all causes	3,686
Total number of deaths, same period—disease only	3,446

Mortality from disease per 1,000 strength for all troops engaged:

Chino-Japanese War	14.8	(Japan)
Spanish-American War	25.0	(U. S.)
Russo-Japanese War	20.2	(Japan)

THE COST OF THE CANTONMENTS

The cost of the cantonments has been very great, but the hugeness of the task, the quickness with which it had to be done, the exorbitant prices which had to be paid under the circumstances doubtless explain the large expenditure and the great excess over the estimates. The estimates were $3,500,000 for each camp. As a matter of fact, the cost of the camps

ranged from $6,700,000 to $11,000,000, as follows:

Camp Travis	$6,700,000
Camp Dodge	6,800,000
Camp Taylor	7,000,000
Camp Gordon	7,400,000
Camp Grant	8,500,000
Camp Dix	8,500,000
Camp Custer	8,700,000
Camp Jackson	8,700,000
Camp Funston	8,700,000
Camp Pike	9,000,000
Camp Sherman	9,600,000
Camp Devens	9,700,000
Camp Meade	10,500,000
Camp Upton	11,100,000
Camp Lee	11,300,000

Of course, the National Guard camps use tentage, and the buildings there range from $2,000,000 to $3,000,000 for a camp.

The reported high commissions earned on these costs have not been understood. They were called "cost plus 10 per cent contracts," but this percentage decreased from 10 to 6 per cent when a certain cost was reached, and in no case could the commission exceed $250,000. The percentage which was earned by the contractors varied from 2 to 3 per cent.

There were two circumstances which added to the cost above the estimate, in addition. One was that the Surgeon General, after the estimates were made, insisted upon 500 cubic feet of inside space per man instead of 365, as had been estimated for. The other was that in August General Pershing's change in the tactical organization to what are called Pershing divisions necessitated an addition to the barracks, which added a very large sum.

The result was that the National Army cantonments cost, complete, about $141,000,000; the National Guard camps, $38,000,000; the embarkation camps, $14,000,000; the quartermasters' training camps, $3,700,000; the machine-shop units, $531,000; and the School of Artillery Fire, at Fort Sill, $680,000, or a total of nearly $200,000,000.

There was admittedly a good deal of waste in this expenditure, due to change of plans; but after reading the evidence on the subject, I cannot find that there is real ground for criticism, considering all the circumstances.

The task was a great one. It was done with much dispatch and the object in view was well served.

JUST COMPLAINT AT DELAY IN TRAINING

The complaint in the camps, from persons competent to make just complaint, was the delay in the proper training of the troops—due, first, to the severe winter, which prevented any satisfactory drill in the open in the northern camps, so that there was no real opportunity to do anything outside, except hikes through the snow, to keep the men in good condition.

The second reason for the deficiency in the training of the men, or its delay, has been in the absence of tools. It took a long time before the needed rifles were furnished, and everywhere was lacking a supply of machine-guns. The management of machine-guns, entrusted to separate companies in every regiment, is a technical matter that needs much training, and there were neither Lewis guns nor other guns with which this training could be had. A third great defect was the absence of field-guns. There were a few on hand, but wholly inadequate in number for proper training of artillery units.

I think it would have been wiser if all the camps in the northern States had been placed in southern States. Even to a layman visiting camps, the greater opportunity for drill was apparent in the marching of the men. A review of 25,000 men, which I was permitted to see at Camp Travis, in San Antonio, showed a degree of drill that could not have been equalled, I think, in any other camp. There I witnessed, too, bayonet drill, bayonet charges over trenches, a sham battle over trenches, with hand grenades, and everything but a barrage of artillery. The difference in progress between that command and those in the far north could not escape the observer.

HEALTH CONDITIONS BETTER IN NORTHERN CAMPS

It is true that the health of the troops in the northern camps was better than it was in the South. The camps which suffered most from pneumonia were Camp Travis, at San Antonio; Camp Pike, at Little Rock, and Camp Funston, near Junction City, in Kansas, where, while

Photograph by Edwin Levick

LEARNING THE ART OF MAKING ONE ROPE GROW WHERE THERE WERE TWO BEFORE

In the curriculum of the sea the gentle art of splicing is included, of course

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LEARNING HOW TO GO "OVER THE TOP AND AT 'EM"

A class of non-commissioned officers of the 28th Keystone Division at Camp Hancock practicing an attack on the enemy trenches

Photograph by Edwin Levick

SEWING SHIRTS FOR SISTER SUSIE'S SAILOR

Knitted sweaters, socks, and helmets from the folks at home are welcomed by the men of America's navy, but there are certain emergency domestic jobs which the hand skilled in training a 15-inch gun has to perform with a portable sewing-machine.

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BAYONET PRACTICE BY U. S. MARINES IN FRANCE

they had cold weather, they had but little snow. These bad health conditions were doubtless due to the unseasonable and unusual conditions at these places.

At San Antonio and at Camp Funston the high winds blew the dust, so that it seemed to carry the germs. At San Antonio the prevailing trouble was influenza, followed by pneumonia. At Camp Pike the pneumonia came from measles. At Camp Funston the dust was dark and almost black loam. When I stepped from the train at that place a high wind was blowing and the dust was so thick that it darkened the faces of the regiment and its officers, so that they, although white, had the appearance of a colored regiment.

But, as already shown by General Gorgas' report, the health conditions are so much better than they ever have been in the past, that while we should not abate our effort to reduce disease, we certainly may felicitate ourselves and the War Department on the comparatively small percentage of deaths and illness.

As already said, at every camp there are four to five English officers and four to five French officers. The uniform testimony of our commanding generals is that these officers have been admirably selected They are men who wear insignia showing that they have been in the trenches and in the places of danger on the front, have been a number of times wounded, and that they are very familiar with the needs of this modern warfare. They work very hard. They are admirable companions, they add to the enjoyment of headquarters life, and they are deeply interested in the work they are doing. They are often discouraged by the absence of tools, but in their lectures to the officers and with such guns and implements as they have had they are entitled to the greatest credit for the progress made.

SINGING AN IMPORTANT FEATURE OF CAMP LIFE

One thing that impresses a visitor to a camp is the real pleasure that the men can derive from singing. They must have a good leader—one who is active and rhythmic and histrionic and almost fantastic. There was one at Camp Devens, named McEwan, whose work with the boys was remarkable. The songs "Over There," "Keep the Home Fires Burning," "Smile, Smile, Smile," "Tipperary," and "The Long Trail" are most catching in their air and most stirring in their effect.

I had the pleasure of addressing four or five audiences of negro troops. I prophesy that they are going to make a very effective part of our army. They take training well and they make excellent soldiers if well led. We have seen that in the Regular Army, in the 24th and 25th Infantry and the 9th and 10th Cavalry, and in the old 48th Volunteers in the Philippines. They are great, stalwart men, capable of enduring much, loving military life, amenable to discipline, and anxious to fit themselves.

THE GREAT LAKES NAVAL STATION

My last assignment, as I have said, was the Great Lakes Naval Training Station, north of Chicago. It was very interesting to visit this and to compare what the navy had done in its one great cantonment with what the army had done. The navy had 25,000 men to drill and train, and this cantonment is therefore about the same size, or a little smaller, than that of the army. There is a great permanent station, with accommodations for some 1,200 or 1,500 jackies in training, and of course this offers conveniences that are used in connection with the cantonment. The buildings are somewhat more stoutly built. They are painted and constructed on somewhat different architectural lines, both of which make them a little more attractive to the eye. They have also what the army has not—two very large drill halls. They gave me a review of 7,000 jackies in one drill hall, and it was evident that these halls in the winter season had been of great advantage for needed training in large bodies.

Another difference was the difference in the age of the men. The men were really between 18 and 22, and in their naval uniform they looked like cadets of a high or preparatory school. They were under excellent discipline, as one could see. They needed no instruction as to saluting, for that seemed a second nature to them, from the discipline they had had.

They were not as well able as the older men to withstand the test of my long addresses, and I thought I discovered a little more somnolence among them than I did among the drafted army. Of course, they were not so mature, but they were very bright, and they were certainly well drilled in the manual of arms and in the calisthenics with their rifles. It would be difficult to select a site where the winter winds have freer sweep than at this training station, but the buildings seemed to be well heated and the command in excellent health.

THE SELECTIVE DRAFT LAW VINDICATED

On the whole, the result of my trip was to confirm me in the view that the selective draft law has vindicated itself in every way. Its democratic provisions, reaching the rich and poor alike, its opportunity for selection of those who can do better work at home, are admirable features. It may be questioned whether the age limit should not be reduced to 18 years and from 31 to 28. Between 18 and 21 young men are less likely to have become settled in life and are required to make less sacrifice in becoming soldiers than men between 28 and 31, and it is not too much to say that men between 18 and 21 will make as good private soldiers as men between 28 and 31. Therefore the cost to the community in lowering the age limit is made less.

The draft law doubtless needs amendment, as defects appear in its administration, but it is a great tribute to the self-governing capacity of the American people that, with so little prepared and trained machinery and so few salaried officers, it has been possible to call upon the body of the country for locally self-created tribunals to administer the law and carry it through effectively.

AN ARMY OF 5,000,000 NEEDED

The law should be amended so as to authorize the President to increase the army from 1,500,000 to 5,000,000 men with the colors, or more. We must win the war, and we should now lay our foundations abroad so as to make that inevitable.

Of course, airplanes, artillery, and other instruments of war are necessary in a modern campaign, and we should increase the supply as far as our resources will permit, but in the end this war, as other wars, must be won by trained man power. We should look forward with large vision and make ample provision so as to strengthen our allies, give confidence to our own army, and convince our enemies now of our determination to win the victory.

I am frequently much concerned to gather in perfectly loyal quarters the impression that the war will be over in less than a year. One may note in many centers of sinister influence suggestions that peace is to be brought about by negotiation with Germany. If this is the outcome of the war, it will be most humiliating to the United States and will only postpone further evil days for her. We have said, through our national spokesman, that we can have no confidence in a treaty made with William of Hohenzollern and his Prussian military régime. This was assumed before Germany's treacherous defeat of Russia through the disintegration of her army. In spite of her phrases of high principle she has disclosed again her real lust for territory and power, in placing her paw on the valuable parts of Russia. Now, therefore, we should be more determined than ever in our purpose to defeat German militarism before we consent to close this war.

WHEN THE WORLD WILL BE FREE AGAIN

We can raise as fine an army and as large an army as there is on European soil, and if we transport it as rapidly as we may and have it all upon European soil within two or three years, our object will be attained and the world will be free again.

On the whole, the deepest impression that is made by the camps and cantonments on the impartial visitor, without technical military knowledge, is the evidences on every side of the loving care of the American people for their boys in the service. Their food is of the best. My own boy in the ranks has told me that they have a tradition among the men—and think it is sustained—that their food is better than that of the officers. The provision in the hospitals, in the Y. M.

C. A., the Knights of Columbus, and the Red Cross, the theaters, the visiting musical, theatrical, and lecture entertainments, all carry the impression of which I have spoken. The men have to work hard. They begin early in the morning and they continue through. Of course, they have hours of leisure, but one of these cantonments is no idle place for any one. It is a manual training school with long hours.

On the whole, therefore, I came away with a conviction that we had begun right. The draft law will win the war through American manhood, with its native courage, independence, and adaptability, instructed and trained in modern scientific warfare.

VOYAGING ON THE VOLGA AMID WAR AND REVOLUTION

War-time Sketches on Russia's Great Waterway

By William T. Ellis

NO TRAVELER fully knows Russia who has not sailed down the Volga River — "Little Mother Volga," as the people affectionately call it — the stream which unites the cold North with the glistening sands of the Caspian depression; which flows through Europe and ends in Asia; which runs from furs to cotton, and which links the Baltic with the Caspian. To journey down the Volga amid the ferment of war and revolution and economic upheaval is to have as good an opportunity as can anywhere be found for studying the composition and mind of this bewildered and bewildering nation.

Naturally, there is no tourist travel in Russia during the war, and an "Americanski" is a marked and favored man aboard the comfortable Volga steamers. Since it befell that duty called me from Petrograd and Moscow to the Caucasus, with an obligation to observe Russia by the way, I followed the circuitous and slower route, in the latter part of August, 1917, thus building up, little by little, day after day, impressions of the people that were clearer than those obtainable in the two chief cities.

This Volga journey is so different from that across Siberia, which I have twice made, that one seems in another world — though both reveal imperial possibilities. These experiences spell in large letters the potentiality of the Russia that is yet to be.

THE STORY OF THE VOLGA

Largest of Europe's rivers, and ranking high among the great streams of the earth, the Volga follows a tortuous, leisurely course, through a watershed three times as large as France, for 2,305 miles, until it pours its waters, through a wide delta of many mouths, into the briny Caspian, the largest inland sea in the world. Its rise is far up in the north, not greatly distant from Petrograd, with which it is connected by canals and the River Neva, thus linking it to the Gulf of Finland.

A large motor-boat or a yacht could doubtless sail from America to the Baltic Sea, and so, through the Neva and connecting canals, down the Volga to the Caspian Sea and the shores of Turkestan, the Caucasus, and Persia. So far as I know, no adventurer has yet essayed this romantic trip, so rich in historical associations and in human interest.

The story of the Volga is the story of Russia. Slav, Tatar, Mongol, and German all have left their impress upon its banks, not to mention the score of minor nationalities and tribes who still fill the eye of the traveling American. Khan

Photograph by Charles E. Beury

A LANDING ALONG THE VOLGA

"The idea of Russia's plenty is visualized along the river. Upstream ships are laden within and without with great hampers of fruit. At some small ports there are literally thousands of watermelons on display. Much of the fresh produce must go to waste" (see text, page 264).

and Mogul, the Golden Horde and the armies of the Czars, have written their stories about this water. The tangled tale of Russia's people and history can best be understood when read in the leisurely comfort of one of the steamers on the Volga.

Everybody has heard of Nizhni Novgorod, famous chiefly for its cosmopolitan annual fair, the greatest in the world, and for the capital place the city has long occupied in the history of Russia. Under normal conditions, Nizhni is only a night's journey in a sleeping car from Moscow. It is the chief city on the Volga and the beginning of navigation for the larger steamers.

A DESERTED CITY

So it was at Nizhni that I began a wartime journey down the river, after a dreary day in the city of the great bazaar; for now the grass grows in the fair section of the Nizhni streets, and the rows upon rows of shops, to the number of about four thousand, are closed as tight as Philadelphia markets on Sunday.

The war has, for this year at least, put out of business the Nizhni Bazaar, to which for centuries merchants have been coming annually from out of the steppes of Tartary; from the villages of far Persia; from the hidden towns of Arabia, and from India, Japan, China, Turkey, and all the lands of Europe. This market-place has been unique in several particulars, one being that all the goods traded in were actually present on the spot. The annual volume of business is given by one authority as 250 million roubles.

Now, by those mysterious news currents which baffle understanding, the tidings had run to the remotest places of earth that there would be no Nizhni Ba-

Photograph by Charles E. Beury

OPEN MARKET AT ASTRAKHAN, ON THE VOLGA

"Russia is huge, and inchoate, and potential. Her people are at present adrift in their minds, as so many of them are adrift physically. They are in the grip of a great negation. Nevertheless, as surely as the turbid and tortuous Volga finds the shining sea, so surely will Russia one day emerge from her muddled and wavering drifting into the clear calm of a great and purposeful and brotherly national life" (see text, page 265).

zaar during 1917—though I was assured in Moscow that it was in full blast! No action to this effect was taken by any official body. Far from it. Nizhni, with the prosperity of its hundred thousand people at stake, hoped until the last. In two of the largest fair buildings, where pathetic trifles were sold to neighboring peasants, brass bands blared daily, in an effort to stimulate life and activity. As if by some occult agreement, the merchants simply failed to come. The shutters of the once busy bazaars, in the height of the historic fair season, were turned like blind eyes toward a world that gave no heed.

The Nizhni Fair of 1917 was one of war's casualties. Whether this archaic institution will ever again revive its ancient glories is a moot question. Will not trade turn to the great city centers of the world and to the conventional channels and usages of purchase and sale? The economic upheaval which has accompanied the world war may easily wipe out this picturesque survival of an ancient order, established at the confluence of the Oka and the Volga.

TRAFFIC ON A BUSY WATERWAY

Even though the Nizhni Fair should pass, the traffic of the Volga is certain to grow, with the reorganization of Russia's transportation system. There are riches of many kinds to be gleaned along the banks of this imperial river, and its waters are rich in fish which are the chief source of the world's supply of caviar. Lumber, hides, grain, wool, fruit, vegetables, and dairy products are among the commonest articles offered to the needs of the many by this productive region. Cotton, too, comes up from Persia in great barges, while the oil fields at

Baku send in large, low-lying tankers only a fraction of the amount of petroleum they are capable of supplying to the upper reaches of the Volga. River craft use no other fuel than oil.

One of the sights of the stream is the huge rafts of lumber, many of them more than 500 feet long, towed at an almost imperceptible rate of speed by side-wheel steamboats. The size of these rafts is indicated by the fact that the wash of the big Volga boats does not have any apparent effect upon them. So long is the Volga journey for the raftsmen that they build log houses on their rough craft, and even occasionally raise vegetables and flowers in miniature gardens. As these men sit gathered about their camp-fires, floating downstream, they afford one of the delightful night scenes of Volga travel. It is woodsmen's life afloat.

As scenery, the shores of the Volga cannot compare with those of many an American river. Along the upper reaches the right bank is hilly and pleasant, but lower down the stream enters the depression that once held the larger Caspian Sea, and here sand-dunes are common, with occasional stretches of real desert. These steppes are inhabited by Tatars, whose cattle come to the river bank to drink and whose camels give a touch of the ancient East to the landscape. Towns are not as numerous as might be expected along so famous a river, although some of the cities have occupied an important place in Russian history.

THE BOLSHIVIK IDEA OF FREEDOM

Recently half a dozen of the Volga cities have made more than a little trouble for the central government by declaring themselves independent republics and so continuing for a few days. What does liberty mean, reason these simple-minded folk, if not the right to do as one pleases? In Nizhni the soldiers rose against their officers and slew many, so that a force had to be sent against them from Moscow. As there was no capital punishment in existence at the time, the insurgents were simply distributed among other military units.

Overshadowing every mile and minute of the Volga journey is the fact of the war and the revolution. It is the topic of private conversation and of public discourse. "Swaboda," or "freedom," soon becomes a familiar sound, even to alien ears. No boat is without its soldier passengers, traveling, apparently, on individual initiative.

Immediately after the revolution, when all sorts of radical conceptions of liberty were abroad in the land, groups of wandering soldiers would take complete control of ships, driving first-class passengers from their state-rooms, on the argument, which I have since heard frequently advanced, in somewhat similar conditions, that the revolution overthrew the rich, and that now the poor should have the best. If the bottom does not come to the top and the top go to the bottom, wherein is the revolution? In one case the soldiers decided, after traveling a day, that they wanted to return to the port of embarkation, so they compelled the captain to turn the ship about and retrace that day's journey!

RAW MATERIAL FOR A MATCHLESS ARMY

That these big blond fellows, in grayish-brown fustian and khaki, could do anything lawless or really vicious seems hard to believe. They are like overgrown, good-natured country boys. They lie about the decks, sleeping most of the time, and as inoffensive as so many St. Bernard puppies. Their capacity for endurance seems limitless. They ask no bed but a board, and can curl up into the smallest space imaginable. For food they have nothing but the soggy black bread, which plays so great havoc with the digestion of foreigners; and often even that is not in evidence. Yet I have seen a group of these hungry soldiers travel for two days alongside great hampers of fruit and never touch a plum.

It is unthinkable that the lawless youngster which is dormant in every American soldier would not have possessed within an hour this unguarded provender. Thoughts of American militiamen clamoring for Pullmans are bound to recur to the traveling Yankee, as he sees the way in which Russian soldiers are herded on cold decks or, worse, in triple tiers of wooden bunks in box-cars.

Everywhere that one goes in Russia

Photograph by William T. Ellis

A VOLGA STEVEDORE

"They heartily bend their backs to unbelievable burdens. Often I have watched processions of them going up steep gang-planks, each man bearing a packing case—a full-sized, full-weight packing case, such as two draymen in America move only by turning from side to side" (see text, page 261).

one sees soldiers. It is estimated that there are 15,000,000 men under arms here, though most of them are by no means at the front. The unorganized way in which they drift about the land is an endless source of wonder. Seldom are they seen by companies or regiments. Only once, and that was in the big training camp outside of Moscow, have I chanced to see soldiers drilling. It is commonly said that the purpose of the old régime in raising so large an army was to create industrial and economic chaos, with consequent disturbances, which would permit Russia, according to the treaties, to make a separate peace.

THE SEDUCTIVE INFLUENCE OF FREE TRANSPORTATION

Whatever was the mind of the old bureaucracy, it has wrought something like a paralysis of industry among the Russian peasants, who, while the women work, are enjoying respite from toil and the pleasures of roving from place to place, with free transportation provided.

Evil propagandists, "exiles" returned from America and from Germany, have greatly demoralized the army. No more fertile field for leadership, either good or bad, can be found in all the world than the Russian soldiers. Of late, however, the leadership has been mistaken. Given a clear vision of duty, these simple, trustful men will do it to the uttermost.

Partings of wives from soldiers are a sad spectacle, witnessed at almost every port of call. There are not many words, and usually only the silent sobbing of the women, until the boat starts, and then there may be a violent outburst that is heartrending to the listener. Much is said of the moral laxity of the Russian people and of the lightness of the marriage tie, but the story of true domestic affection is revealed in too many of these

Photograph by Gilbert Grosvenor

BEGGAR AT NIZHNI NOVGOROD

Russia has many beggars. But even among them one sees, in spite of their rags, faces that proclaim good hearts and genial souls. Better a beggar without even a crust of black bread than the well-fed barterer of his country's weal!

scenes of separation for the observer to accept entirely such cynical generalizations.

Often they have their lighter side. At one wharf it was the wife and son who were leaving the soldier husband and father. Into the midst of the parting came a procession of stevedores, bearing great sacks of sunflower seeds, a common Russian delicacy. One man's burden struck a snag, there was a rent in the burlap, and forth poured a flood of the black and white seeds. Instantly the soldier's cap was off and he was holding it under this stream of unexpected bounty. What spilled to the ground other soldiers and small boys gathered, heedless, as they cracked the seeds skillfully in their teeth, of either dirt or germs. Thus the strain of one separation was relieved, for the wife, aboard the boat, was glad to see her husband's larder enriched.

WIVES TRAVEL WITH SOLDIER HUSBANDS

Occasionally, as in Mexico, the wives accompany their soldier husbands, their household effects wrapped in bundles and a baby or two on their arms or clinging to the mother's skirt.

Only one glimpse did I have on the Volga trip of the women soldiers, of whom I had seen many in Petrograd and Moscow. This was at Saratov, where a company of women soldiers were marching through the streets, led by a man officer. A moment before a company of male soldiers had passed, singing lustily the unforgettable Russian marching songs, which are their military music; but these women moved in grim silence, with set faces.

All of them were young—the youth of the Russian women soldiers is the first characteristic that one notices—but their cheeks were bronzed and their uniforms, which are the same as those of the men, were old. Many of them did not have puttees, and their footwear was varied, canvas shoes predominating. All of them wore their hair short. Clearly, for this particular group, the stage of novelty and enthusiasm had passed and had been succeeded by sheer resolution. Most of the glamour of soldiering had disappeared.

They marched in good formation, but

Photograph by Gilbert Grosvenor

CAB DRIVER AT NIZHNI NOVGOROD

The great fair city, where once the buyers of the world journeyed for barter and trade, is now almost as much a deserted place during the fair season as once it was in the northern mid-winter. Like Russia's martial spirit, it lies dead—perhaps beyond the hope of resurrection!

with more of doggedness than abandon or sprightliness.

All of these women soldiers belong to the everywhere popular "battalions of death," who are pledged not to retreat or surrender. Their effect upon the men soldiers has been twofold: some regard them as inspired saviors of the country, a sort of Joans of Arc; while others are inclined to jeer and make scurrilous remarks. In no instances, though, have the men given evidence that they regard the formation of women's battalions as a reflection upon themselves.

SPRING BEDS UNKNOWN TO THE MOUJIK

But, then, these private soldiers, over whose sleeping forms I have often stumbled on the dark decks and in unexpected corners of docks and highways and sta-

VOLGA RAFTS ARE HUGE

Sweeping down through eastern European Russia from a point southeast of Petrograd, first east to the great bend at Kazan and then south past Samara and Saratof to Astrakhan, the Volga, unparalleled by a railroad, and only occasionally crossed by one, is a great artery of trade up which move the products of Trans-Caucasia and Turkestan, and down which comes the commerce of northeastern Europe bound for southeastern Asia.

A TYPICAL VOLGA TOWN

Photographs by William T. Ellis

In times gone by many of the cities of the Volga region were wealthy and prosperous, taking toll from a rich river trade. Now they are all but starving. It is dishonorable now in Russia to be provident, and unpatriotic to advocate the keeping of international covenants, and prosperity can never dwell in any country that entertains such sentiments.

tions, are not a keenly sensitive lot. They are used to a rough life; hardships are no new experience for them. When I would commiserate them for sleeping on iron decks or on wooden shelves or on the ground, I recall that they have never known spring mattresses. The black bread that makes ill those unaccustomed to it has always been their usual fare. A care-free, singing, sleeping—especially sleeping—lot of boys on a holiday they are, lacking the ebullient spirits of youth.

Only the manual laborer can understand their enjoyment of respite from toil. Most of these men, whom our boat so casually takes on or gives up at ports on the way, had never, before the war, been 25 versts from the villages in which they were born. Now they are tasting the irresponsibility of the open road, adventuring into far places and new scenes, learning as they go all sorts of new facts and theories about life. By way of its soldiers the whole of Russia has suddenly been put through a course in cosmopolitanism. These men are of themselves unenterprising and strangely lacking in initiative. They are not trouble-makers; a more inoffensive crowd of patient and long-enduring men may scarcely be imagined. Perhaps the simplest explanation of the absorbing phenomena of the Russian soldiers is to say that they are at present merely raw material—men in the making, but for the moment only children. They are sorely befuddled by the lack of leaders and slogans and standards; therefore they are drifting aimlessly about the land — unorganized, undisciplined, undirected, and ready to follow the mad radicalism of the first "boulshevik," or extreme socialist, who gets their ear—and the Maximalists have shown an efficiency in propaganda that has been their one achievement in revolutionized Russia.

WHAT LEADERSHIP COULD ACCOMPLISH IN RUSSIA

If, instead of the radicals, the real patriots and democrats of Russia were instructing and inspiring the soldiers, so that the troops would have a comprehensible battle cry and a simple objective, there would be no withstanding these physically virile fellows.

Quite different were the group of soldiers who came aboard our boat at Kazan. Such as had uniforms seemed to be wearing those of the Austrian army, as we had come to know it from observation of German and Austrian prisoners in many towns and cities of Russia. These men, 30 in number, were singularly alert and well kept, their uniforms, or semi-uniforms, being in an admirable condition of spruceness. Each man wore a red and white ribbon somewhere on his coat, and we speedily learned that they were Czechs, or Bohemians, who had been conscripted into the Austrian army, and at the first opportunity, during the battle of Lemberg, two years before, had voluntarily surrendered to the Russians.

After the revolution the request of these Czechs to fight on the side of liberty had been partly acceded to. At the recent debacle on the Galician front these Czechs had behaved so valiantly that Kerensky had given them permission to form a separate Czech unit, and our fellow-passengers were on the way, via Samara and Kiev, to join their compatriots on the eastern front.

When asked what would befall if they should be captured by the Austrians, they cheerfully and graphically explained that they would be hanged; but that it was an unwritten agreement among them that before falling into the hands of the nation from whose power the Czechs seek liberation they would do as other Czechs had done at the time of the eastern retreat—shoot themselves.

THE CZECHS DESERT TO LIBERTY'S ARMIES

The ardor and intelligence and patriotism of these men, going smilingly to death for the old cause of self-government, was refreshing. When we proposed photographing them, they asked that it be beside their red and white flag, which flew from the steamer's top deck. This standard bore the words, "Czech Volunteers. Forward for Liberty!"

Every man of the thirty has relatives among the two million Czechs, or Bohemians, who have emigrated to America, most of them being found in Pennsylvania and in Chicago. There are eight million left behind, and these, we were told, are a unit in desiring independence.

Photograph by Gilbert Grosvenor

TWENTY-FIVE MEDALS DECORATING A POLICEMAN AT NIZHNI NOVGOROD

In the old days decorations were widely bestowed in Russia. Almost every supporter of the dynasty could wear one or more of them. But now who wears a badge is bourgeois and anybody who has anything is anathema. "Liberty, what crimes are committed in thy name!"

We saw our Czech friends later, marching in fine formation through Samarra, to the music of their own weird, staccato song, going gaily forward, buoyed up by the greatest of purposes, to the line of battle. They broke their discipline long enough to salute and then cheer their American friends—one more of the countless moving tokens of the kinship which all the freedom-loving people of earth have with the great Republic of the West.

To be an American, anywhere among the allied nations at the present time, is to be the recipient of uncounted marks of consideration. The two "American-skis" on the Volga boat were especially favored in every way, and telegrams evidently preceded them at all points of change or debarkation; so that, amid all

the riot and clamor of a congested traffic, with the impossibility of providing accommodation for those desiring it, the Americans were cared for at every step of the journey.

RUSSIANS LIKE THE "AMERICANSKI"

Officials of the boats, army officers, and private citizens vied with one another to show courtesy to the Americans. While Russia is full of stories of the malicious efforts of the returned radicals from America—some of them unquestionably paid pro-German agents — to foment a feeling against the United States, and to attribute all sorts of sinister motives to our efforts to serve Russia, the experience of an American who has already traveled 8,000 miles in Russia is that the eyes of even the peasant and the soldier light up with new interest and friendliness at the word "Americanski" or at the sight of the little button flag on the coat lapel.

Photograph by William T. Ellis

ARMENIAN CHILDREN OF THE VOLGA REGION

Until the hand of history ceases to write down the chronicles of man and its records are forgotten, the world will never look into an Armenian face, be it that of youth or age, without recalling with a shudder the tortures these people have endured at the hands of the Turk. Their poverty is bad, their lack of human liberty is worse; but their bitter persecution ranks with the cruelties of the darkest ages and the most despicable tyrants of history.

When we were introduced aboard the boat to Kerensky's assistant minister of war, en route to inspect the great munition plants at one of the Volga cities, the general straightway gave us an autograph letter to the commander in the Caucasus, ordering that all things be placed at our disposal, clear down to the front line of fighting, simply because we are Americans.

As the clear waters of the Kama, itself an imperial river, flow into the turbid Volga, keeping distinct for a time, like the waters of the Yellow Sea and the Pacific, but ultimately blending, so the Volga River basin represents the great blend of the diverse races that go to make up this marvelous Russia.

A POTPOURRI OF RACES

The distinct types are ever clearly before one, and also the amalgamation of the Slav and the Teuton and the Tatar

Photograph by William T. Ellis

RUSSIAN SOLDIERS ON A VOLGA BOAT: EVENING

Creature comforts are almost as unnecessary to the Russian peasant as are sheer luxuries to the people of the western world. He never slept in a bed with springs in his life, a bath-tub is all but an unknown quantity to him. Give him a pillow for his head, black bread and soup for his stomach, and simple clothes for his body, and he has fewer worries than the ox that grazes in the pasture.

Photograph by Charles E. Beury

WAKING HOURS ON A VOLGA RIVER STEAMER

"The story of the Volga is the story of Russia. Slav, Tatar, Mongol, and German, all have left their impress upon its banks. Khan and Mogul, the Golden Horde and the armies of the Czars, have written their stories about this water. The tangled tale of Russia's people and history can best be understood when read in the leisurely comfort of one of the steamers on the Volga" (see text, page 245).

and the Semite. It is not easy to tell which of one's fellow-passengers are predominantly Slav and which are Mongol; Persian and Armenian sit side by side at the table, and until pork is served the American cannot tell them apart. So do costumes blend. Yonder Chinese (or is he a Mongol?) wears a wholly Russian costume, and our tall Cossack may be either a Georgian or a Circassian, though he looks like an Armenian.

As with the blood and costumes, so also is it with customs. Below us, on the forward deck, sits a family drinking tea from bowls, which they hold in uttermost Chinese fashion, rather than from glasses, in the Russian mode; yet one of the women wears a wrist watch and all are dressed as Slavic peasants. Alongside of them sits a woman who is combing her own hair, for various little reasons, while another is performing the same office for her neighbor, in the friendly fashion of India and of all oriental mothers.

The hair is a point of pride with both men and women in this country. Not only aboard ship, but even in the best restaurants, I have seen men publicly combing both beard and hair; frequently I have observed it among men at table. Even in the midst of the church service an occasional Russian priest will comb his flowing beard and locks; and I saw bishops and archbishops, in the anteroom of the procurator of the Holy Synod, make a complete toilet with huge combs which they carry hidden somewhere in their robes.

EXAMPLES OF HIRSUTE EFFULGENCE

On the other hand, there are apparent Nazarites who give no heed to their wild, unshorn locks. For example, there was the young chap whom we dubbed Horace Greeley, with his soft, straggling beard and a quizzical look behind his ill-fitting, silver-rimmed glasses, as if he were ever in the glare of the sun. His straw hat was fastened by a string, and he carried a carpet-sack, from which he was continually drawing forth food, so that his time was divided, like that of most Russians, between smoking and eating.

Many peasants and soldiers pay no other attention to hair, apparently, than to cut it off square before it reaches the shoulders. For hirsute effulgence, however, commend me to the genial izhvostiks, or drosky-drivers, of Nizhni Novgorod; their whiskers are as ample as their coats, which, as all who have seen Russian Jehus know, is superlative speech.

The greatest blend of Volga River travel is found among the fourth-class passengers. First-class cabins, high-ceiled and spacious, with no upper berths, are forward on the upper deck, with plate-glass windows in dining-room and music-room. Second-class passengers are aft on the same deck, with cabins and their own dining-room, the overflow sleeping in the dining-room. There is no distinction on deck between the two classes, and even the third and fourth classes, in addition to the soldiers, promenade the upper deck, in a merging consequent upon the revolution.

SCENES WITHOUT PARALLEL IN THE WESTERN WORLD

The third-class passengers have bunks, two tiers high (I have even seen men sleeping on the narrow luggage shelves above the bunks), while the fourth class simply camp down amid their luggage on the deck—forward, aft, along the rails, or wherever else they can find a foothold. The footway alongside the oil-using engines is lined at night with sleepers—men, women, and children—with faces screwed up beneath the glare of the electric light.

This is a scene with no parallel in the western world. Slavs, Mongols, Jews, Persians, Tatars, Circassians, Armenians, and gypsies all herd together in what appears to be a conglomerate and inextricable mass of misery. Each family or group is perched on or beside its bundles—bundles of cloth or of oriental rugs, some of them beautiful—and its baskets. Occasionally there will be seen an imitation leather gripsack or a gaily-colored tin trunk.

As most of these people are traveling with their household goods, it is easy to see what a family prizes. This one has a battered dressmaker's form. Yonder one iron dumb-bell, weighing 15 pounds or so, which a woman carefully treasures.

A VOLGA STEAMER

"As the clear waters of the Kama, itself an imperial river, flow into the turbid Volga, keeping distinct for a time, like the waters of the Yellow Sea and the Pacific, but ultimately blending, so the Volga River basin represents the great blend of the diverse races that go to make up this marvelous Russia" (see text, page 255).

Photographs by William T. Ellis

LANDING GRAIN FROM A VOLGA BOAT

Germany's scheme in the East is to open up the wheat fields of southern Russia by the separate peace route and move foodstuffs up the Danube into the heart of the Teutonic Alliance. Therefore, every ounce of butter, every pound of flour, every piece of meat, you save for the Allies is America's answer to Teutonic designs.

Photograph by William T. Ellis

LOOKING DOWN ON DECK PASSENGERS

It's a motley medley of human freight you see on the river boat of Russia in 1918. These steamers are packed and crowded and jammed. White Russians, Red Russians, Little Russians, Kirghiz, Turkomen, Gypsies—a great medley of humanity, few seeming to feel or care that the world is on fire and western civilization in the balance, so long as they can rest from the burdens of the time.

Musical instruments are common, and a huge gramaphone horn is not infrequent. A child's toy sometimes has a pathetic first place. Sewing-machines are not rare. But mostly the array is bundles, huge and shapeless. Frequently baskets of fowls are carried. One sunny morning I made count of what I saw on the iron main deck, aft, in a space 25 by 45 feet.

SUCKLING PIGS AND SICKLY CHICKENS TRAVEL WITH THE FAMILY

There were 60 persons in all visible, besides luggage. Fifteen of them were asleep and 45 were awake. Most of the passengers were women; some of the groups had not a man among them. But, then, the Russian peasant woman asks no odds of man in any test of strength, intelligence, or capability. Two of the women below, as I watched, were coddling sickly chickens in their arms, the fowls evidently having been victims of the congestion in the baskets. Another woman was airing a suckling pig on her knee. Two women were knitting socks and two were making the toilets of children.

One woman was counting her money and wrapping it up in a rag—the dirty paper currency, which, in denominations of 30, 25, 20, 15, and 10 kopecks, is in the form of postage stamps, while the one, two, three, and five kopeck notes are larger, the 50-kopeck note being larger still. There is no clink of currency in Russia now. Metal currency has disappeared, save for some coppers down in the Caspian region. An American gold piece is worth five times its ante-war value; and in the bazaars, owing to the many-fold depreciation of the rouble, one may secure incredible bargains by the display of a gold coin—which is no little comfort, after the staggering war prices that are one's daily experience.

To return to the deck scene: Half a dozen of the women are eating and drinking, while one woman is selling scrubby apples, which customers cut into bits and put into their tea—almost anything edi-

Photograph by William T. Ellis

SOMETHING TO EAT AT A RIVER PORT

"That these big blond fellows in grayish-brown fustian and khaki could do anything lawless or really vicious is hard to believe. They are like overgrown, good-natured country boys. For food they have nothing but the soggy black bread which plays so great havoc with the digestion of foreigners; and often even that is not in evidence. Yet I have seen a group of these hungry soldiers travel for two days alongside great hampers of fruit and never touch a plum" (see text, page 248).

ble being an acceptable addition to the ubiquitous glass of tea. Four men are playing cards for money, while an eager company of spectators throng about them. Others are talking, smoking, eating, or scratching. Nobody seems unhappy, despite the huddled mass they all compose.

HANDS AND FACES GO UNWASHED

In this same space, occupying a fair half of it, we had earlier carried a company of dirty, ragged gypsies, who went ashore gypsy fashion, the man carrying the baby, and the woman carrying the tent-poles. I had noticed the man sewing on his corduroy trousers, while his wife stitched the tent. These people, with their black-eyed elves of youngsters, had contrived to improvise a tent on the deck; so they had a measure of privacy, though there was evidence that it was not privacy, but protection for their heaps of nondescript bundles, that they desired. The gypsies were troubled even less than the other passengers by the lack of opportunity to wash their faces.

Perhaps a woman could have told how these deck passengers were dressed; it baffled me, for the raiment of the women seemed to be a general wrapping up. The distinctive and attractive costumes are worn by the men.

In one particular the peasant women of Russia and most of the East really have an advantage over their Western sisters: they and their husbands are freed from the tyranny of the milliner, for they wear nothing more than a kerchief or a shawl about their heads. Often these are the soft and beautiful Persian and Cashmere weaves; and I have seen on the heads of peasant women shawls richer by far in texture and color than any creation of a Fifth Avenue milliner. Their blend of harmonious hues and graceful designs is

so beautiful that the traveler covets them every one.

FORMIDABLE HEADGEAR

Even the elaborate headdress of the men is never so delightful as the best of the shawls worn by the women; but it is more striking, especially as the traveler draws near to Persia and the Caucasus. Huge lamb-skin shakos, of all shapes and no shape, are the accepted headgear even for August. I have seen them two feet high and almost as wide.

To counteract the warmth, or for other reasons, the Moslem keeps his head shaved; and the appearance of a man with a heavy black beard and no hair above his ears is at least unfamiliar to Americans. At every landing one catches new suggestions for comic costumes for stage use.

We carried from Astrakhan to Petrovsk a Persian whose lamb-skin hat, never seen off his head, at meals or at night, was no blacker than his villainous beard, which did not conceal the fact that his chin was only an inward slope, and that his teeth lapped fondly over each other. His eyes roved perpetually, in different directions, and he was ever on the grin. His coat was a long, gray one, with spreading skirt, and his shoes were picturesque green.

He was no more picturesque than the long-haired "anarchist"—who may have been merely a genius from New York, visiting his native Russia!—wearing what appeared to be a suit of pajamas, braided with black cord and frogs, and a black Windsor tie. He did not, however, as do many Russian men, wear a bracelet. At least he looked cool, whereas not a few of his fellow-passengers wore furs, making no change of costume the year around.

WHERE BATHING SUITS ARE UNAPPRECIATED

Nobody here sees any incongruity in persons clad in heavy furs and woolens looking over the rail at the natives—men, women, and children—bathing unclad. I have seen many bathers in various parts of Russia, but I have yet to see the first inch of a bathing suit. Even at Petrograd I passed a woman bathing in the Neva within a hundred yards of passing tram-cars.

This leisurely travel gives occasion for philosophising upon many of the vanities of life. Thus, I have observed a greater number of handsome men at Volga landings than appear on all the moving-picture screens of America. Most of them were hamals, or coolies, or, as we would say, stevedores, dressed in rags, with a cumbersome pack-saddle on their backs, upon which they commonly bear loads of two and three hundred pounds. Unlimited material for matinee idols—Persians with regular features, black moustaches, and large, languishing eyes—is living its life of merry jest and cheer along the Volga, carrying burdens which two men would not essay on the docks of San Francisco or Philadelphia.

They have never heard that "Beauty is its own excuse for being," so they heartily bend their backs to unbelievable burdens. Often I have watched processions of them going up steep gang-planks, each man bearing on his back a packing case—a full-sized, full-weight, packing case, such as two draymen in America move only by turning from side to side. Nothing is carried except on the back. I saw a large drop-forge being borne ashore a few days ago, and while three other men were steadying it, the weight of the machine, which could not have been less than 500 pounds, came on one man's back. These professional burden-bearers of the Near East, Kurds and Persians and Armenians, carry heavier loads than even the Korean coolies or the hill-women of the Himalayas.

SONGS AND HORSE-PLAY LIGHTEN THE TOILING HOURS

As they toil they sing. Quips and jests and horse-play are common with these human drays as they race with one another up and down gang-planks. Songs of the Volga toilers are known everywhere, but I never heard them so well done as one night at a port where a square box, evidently containing a stone of many hundred-weight, was to be dragged aboard. It was placed on a long plank, as if to increase the friction, and this was drawn by ten men, pulling upon one rope. An extra stone, weighing two or

three hundred pounds, was carried on top of the box, as a mere unconsidered trifle.

At home, of course, rollers would have been put under the plank and the whole moved forward easily; but labor-saving devices have yet to find their way into this land, where man-power is the cheapest of commodities. As the team of ten men strained at the rope, they sang. Their leader, or cantor, was a long-whiskered patriarch who would have made a model precentor for a Presbyterian church—provided he left his dinky little round hat in Russia. He carried the solo parts of the chantey, and the chorus came crashing in with deep responses, richer by far than anything heard on the Potomac or the Mississippi. The performance would have gladdened a musician's heart, who straightway would have transcribed its melody. How the hardest toilers sing, the world around!

The Russian love of music appears in many forms. Frequently at ports of call we would be serenaded for alms by a crippled soldier and his family or by a group of maimed comrades. The man would play the accordeon—the piano of the peasant—and his companions would sing, and sing effectively, as apparently all Russians do.

SING, EVEN THOUGH YOU SUFFER

There is a strain of plaintiveness in these folk-melodies, even as in their church services, where the unaccompanied choirs make music that is famous for depth and richness. These long nights on the river, with an accordeon or the Russian triangular guitar usually within sound, gave one a fondness for the strains of this simple music. After all, it is a fine philosophy that these cripples and peasants teach: Keep your music portable; and if you suffer, at least sing. To rafts and docks and shores and passing craft, as well as from the fellow-passengers crowded on the deck below, I owe a remembered debt for Volga music.

Occasional landings break the monotony of the voyage down the river. Between Nizhni Novgorod and Astrakhan, the two terminal points of the steamers, there are several cities of historic and commercial importance—Kazan, Simbirsk, Samara, Saratov, Tzaritzuin. Passengers have time to go ashore for sightseeing and for shopping, although the latter, nowadays, has to do strictly with the food supply.

From the American's viewpoint, Saratov is the best city of the group, although many an American town of one-fourth its size is better built and kept. These lower Volga cities show the predominance of the Germans, who were settled there by Catherine the Great and who lately have been more than a little inconvenienced by their German sympathies.

This element accounts for the presence of conventional western church spires in these cities and towns, for the settlers have remained Lutherans. Roman Catholic churches are more numerous, also, in this section. Even along the lower Volga the Greek churches and cathedrals, some of them very old, since this is not new country, dominate the landscape. Frequently the great church, with its domes and campanile, will be the one pretentious structure in a community. The vogue of the campanile, some examples of which, like the churches to which they are attached, are really beautiful, is sure to be remarked by the Volga traveler.

APPROACHING THE HABITAT OF THE MINARET

Not until he comes to a few picturesque Tatar mosques, as the boat nears Astrakhan, does the minaret appear; and even in the surprising and motley city of Astrakhan the mosques are few and humble and their minarets resemble the steeples of small country churches at home. One who has traveled much in the Near East, and is accustomed to the subordination of the church to the mosque, takes a rather unchristian satisfaction in the spectacle of an oriental region where the church buildings dominate the landscape.

That this is the East, one's ears make clear at every port. The noise is the babel of human voices; not the rumble of machinery or of motor-cars or of railways, but the shrill shoutings of the Orient, which does nothing without clamor. Quarrels are almost entirely verbal. I have not seen one stand-up and knock-down fight in all the turbulent experiences of travel in Russia; the nearest to it was

when two cabbies, or izhvostiks, clutched each other's big padded coat and pushed and pulled while they cursed.

The Russians really are a peaceable people, of a surpassing kindliness. In some of the worst jams aboard the boat I have heard the women use language such as on the battle front is transmuted into bullets; but of the good nature which usually prevails amid congested travel conditions, one cannot speak too highly.

FOOD THE PRINCIPAL OCCASION OF EXCITEMENT

Most of the excitement at ports of call has to do with food. This phase of the Volga voyage, or of life in Russia itself, deserves a chapter apart. The meal hours on the big passenger steamers were simply incomprehensible. Of course, "chai," or tea, was served, or made, in one's cabin or in the dining-room, at the time of arising, which might be anywhere from 9 to 12 o'clock. Nothing is served in the dining-room or from the kitchen and pantry between the hours of 12 and 2 o'clock at mid-day or between 6 and 8 o'clock in the evening! This is the rest-time of the servants.

Since the revolution all sorts of radical changes have come about in the lot of waiters, cooks, chambermaids, and other domestics. For one thing the fee system has been abolished, except in the case of hotel porters. Fifteen or 20 per cent is added to one's bill for "service."

Reforms in the hours of labor have also taken place; so that, for example, in Astrakhan it was impossible to secure a morsel of luncheon before 1 o'clock at the city's one leading restaurant. The night before it had been 8 o'clock before the Arcadia restaurant opened, though the hungry Americans got something to eat an hour earlier by being admitted to the city's leading gaming club, which had a buffet attached. On the boat, as I have indicated, there was strictly no business done in the culinary department within the hours when all Americans are accustomed to their meals.

As it worked out in practice, one's order for luncheon was taken at 2 o'clock and he was lucky if he got something to eat by 3. Commonly, we sat down to dinner in the evening at 10 o'clock. If it were not for individual stores of food and tea-making outfits, there would be real suffering, since the distance between tea and bread upon arising and luncheon at 3 is of Marathon magnitude to a hungry American.

Contrariwise—and Russia is a land of contraries—the very next steamer we took, from Astrakhan to Baku, on the Caspian, served meals promptly at western hours—"little breakfast" at 8, luncheon at 12, and dinner at 6. So the eating habits of Russians may not safely be generalized upon, except that they eat with frequency and with disregard of standardized usages.

FORAGING AS A FINE ART

War's gentle art of foraging is no new acquisition for Russia. All travel is based on the assumption that most of the passengers will carry food with them or secure it en route. It is the rare person who depends entirely upon the dining-car or the ship's restaurant.

It is perfectly *au fait* for a gentleman, and even for a military officer, to enter the dining-room with a box of caviar, or a loaf of whitish bread and a couple of cucumbers, or a jar of jam in his hands. It may be that he carries dried fish by their tails or a watermelon under his arm. It is to secure these supplies that passengers rush ashore at every stop. Most have come from the sad and soggy black bread of Petrograd and Moscow; and before they are far down the Volga they find themselves in the realm of plentiful white bread, or near-white bread, and even, in some places, of real pastry.

There is abundance of grain in some of these towns, but the local committees will not permit it to be shipped out—another illustration of the everywhere-apparent fact that Russia's fundamental need is organization and transportation. The traveler has scarcely come out from under the depression of the bread lines of the North, and the nightmare of black bread, when suddenly, at Astrakhan, he finds himself once more in the black-bread-line zone. Of dairy products and fruits—milk, butter, cheese, eggs, melons, potatoes, onions, egg-plants, tomatoes,

Photograph by William T. Ellis

SOME OF OUR CZECH FELLOW-PASSENGERS ON THE VOLGA

"These men were singularly alert and well kept, their uniforms, or semi-uniforms, being in an admirable condition of spruceness. Each man wore a red and white ribbon. They were Czechs, or Bohemians, who had been conscripted into the Austrian army, and at the first opportunity, during the battle of Lemberg, two years before, had voluntarily surrendered to the Russians. After the revolution the request of these Czechs to fight on the side of liberty had been partly acceded to" (see text, page 253).

beans, apples, peaches, pears, plums, and luscious grapes—there is no stint in Astrakhan; but bread and sugar are procurable only by ticket.

Many river ports have food in plenty and the peasant women bring it down to the wharves. During the time the steamer is at the dock the scene is a busy one, passengers milling about, like cattle in a corral, as they pass from vendor to vendor, seeking bargains. This frequent exodus to the shore of shoppers for food is the most absorbing spectacle of the Volga River journey. It never loses its human interest.

WHERE GERMS ARE NOT SUSPECTED

The peasant women and children are patient, pleasant, and shrewd merchants. Neither they nor their customers are bothered by such trifles as dust or germs; for the only booths of this bazaar are baskets and a few feet of earth along the dusty dock or its approaches. Here round loaves of dusky bread, 18 to 24 inches in diameter, are displayed, that they may later be gathered to the bosoms of hungry passengers and borne to their cabins. Lucky is the soldier who can pillow his head upon one of these loaves by night and munch upon it by day.

The idea of Russia's plenty is visualized along the river. Upstream ships are laden within and without with great hampers of fruit, carefully sewn beneath cloth covers. At some small ports there are literally thousands of watermelons on display. Small fruits are abundant. Some things are even cheap at places, as a watermelon for 10 or 15 cents and a loaf of bread for about the same.

Much of the fresh produce must go to

waste. The passengers on the boats do their utmost to prevent that undesirable fate for edibles, for they seem to be always eating, eating, eating. I cannot recall a single stroll around the deck, at any hour of day or night, when I did not see somebody eating and drinking. The overcrowded peasants on the deck below and the saloon passengers above are alike in this, that they are continually producing from their stores some sort of food to be eaten with the ever-present tea.

Still, one need not always study his fellow-passengers. There is the scenery of the shore, which, further down, includes the villages of the various Tatar tribes, with their round houses that look like haystacks; and far reaches of rolling meadow land and wheat fields; and hills and forests, and sand-dunes and towns and cities, with the wild ducks and geese flying between.

AN ENDLESS PROCESSION OF RIVER CRAFT

Then there is the incessant procession of boat life; 2,000 steamships regularly ply upon the Volga. Big barges, in groups of five or six, with half a dozen small boats clustered like barnacles behind, are towed by side-wheel tugs. Fishing craft, manned by Karmacks and other natives, glide by or are passed at anchor. From the shore comes the sound of church bells, made musical by traveling over the water.

Sunsets of surpassing loveliness, and sunrises which few Russian passengers see, cast a spell of peace over one's spirit, and the war seems for the moment distant and unreal. It is difficult to realize that upon every incident of the trip is stamped the grim seal of Mars. Every soldier on the decks; all the man-work done by women; each scramble for food; the almost total absence of pleasure-seekers from these passenger steamers at the height of the Russian travel season; the partings by the way; the munition factories on the river banks; the driving of all passengers indoors when the ship passes under the great railway bridge across the Volga—all these spell the life and death conflict, internal and with a foreign foe, which Russia is waging.

As the reader has perceived, I have been endeavoring to portray enough characteristic incidents of a large and representative section of Russia to make clear something of the condition of the place and the people.

Russia is huge and inchoate and potential. Her people are at present adrift in their minds, as so many of them are adrift physically. They are in the grip of a great negation; the old order of autocracy has been cast off forever. But the great essentials and affirmations of democracy have not yet taken hold of this conglomerate and simple-minded mass of children. Nevertheless, as surely as the turbid and tortuous Volga finds the shining sea, so surely will Russia one day emerge from her muddled and wavering drifting into the clear calm of a great and purposeful and brotherly national life.

Photograph by Charles K. Moser

OUR PARTY, ALONG THE WADI MOTAHA, ENTERING THE HILLS IN SEARCH OF FRANKINCENSE TREES: SOCOTRA

THE ISLE OF FRANKINCENSE

By Charles K. Moser

Formerly United States Consul-General to Aden, Arabia

SINCE the days of the ancient Egyptians, frankincense has been employed in the religious rites of many peoples. Intrepid merchants of Persia and of Phœnicia sailed their argosies to the edge of the unknown in search of the fragrant resin equally prized by the high priests of Judah, the vestal virgins in their incense offerings to the gods, and the Romans who employed its perfume in the celebration of triumphs to their victorious Cæsars.

Frankincense is a gum resin obtained from certain trees of the genus *Boswellia,* found in East Africa and Arabia. An incision having been made in the bark of the tree, a milky juice exudes and slowly hardens in tear-shaped drops of yellowish hue. These are gathered as olibanum, or the true frankincense. The idea that frankincense was originally a product of India probably arose from a confusion of it with other odoriferous products of that country, and because of the fact that imported frankincense is sold with native Indian products.

In the Roman Catholic Church today it is recommended that frankincense constitute as large a proportion as possible of the incense used. In the Russian Church benzoin is much employed. The silver fir tree of Europe furnishes a resin which is the common frankincense of the pharmacopœias.

Among ancient and medieval peoples frankincense was the physician's cure-all, being confidently administered for fevers, boils, internal disorders, leprosy, as an antidote to hemlock poisoning, as a sedative, a stimulant, and a tonic.

SOCOTRA, ANCIENT SOURCE OF FRANKINCENSE

As a chip hurled from the woodsman's ax, Socotra seems to have been torn off in the making of Africa and flung away into the Indian Ocean. In ancient times Socotra and the southern Hadramaut produced all the frankincense in the world, but today the largest supply comes from the Warsangli country, in Somaliland.

This fragment of the Dark Continent, 73 miles long by 35 miles wide in its widest part and lying 543 miles east of Aden, is said to be geologically older than eastern Asia; yet in the centuries which have elapsed since the argosies of Persia and Tyre sought it out for its precious balsams it has been almost forgotten. The Europeans who have visited it could be counted on one's fingers. Every ship that passes through Bab-el-Mandeb, east or west, sights its cloud-belted peaks—and gives it room; for Socotra has no harbors, and the monsoon snarls about its uncharted rocks like a hungry lioness lying in wait for her prey.

It was my good fortune to be one of a party, headed by His Britannic Majesty's Resident at Aden, which left the latter city with the intention of adventure and a week's camping-out in the cool Socotran Mountains.

AWAITING A ROYAL VISITOR

By great luck we had excellent weather, and at dawn on the third day we dropped anchor in a shallow bay, smooth and transparent as glass, about three miles from a long, curving, yellow beach backed with palm fronds. Still farther back stood a vast rampart of gray limestone mountains sticking needle-pointed peaks up into the clouds. These were the peaks of Haghier and we were anchored in Tamarida Bay. Before us, smothered in the palms, lay Hadibo, the capital of the island.

For an hour we awaited some signal to indicate that our presence had been observed. A royal visitor was expected to breakfast—His Highness the Sultan Hassan ibn Imad, lord of the isle of frankincense and of Kishn, on the south Arabian coast. Sixty feet below us, through the

Photograph by Charles K. Moser

COMING DOWN OUT OF THE MOUNTAINS: SOCOTRA

marvelously clear water, could be seen sponges and pink corals growing on the bottom; not more motionless were they than the life on shore.

Finally, a lonely figure detached itself from the beach and came shoveling (there is no other word to describe it) a three-log raft through the vitrescent water. He proved to be an ancient fisherman so remarkably like little Alice's friend that one of the ladies dubbed him the "Gogglywoggle" (see page 275). He had shells, fish of brilliant colors, and striped pots to sell; but at first trade languished. To every tender of money the Gogglywoggle shook his head. We were puzzled until an inspired Lascar offered him a handful of rice. Ten minutes later the old fellow had disposed of his entire stock for a few pounds of rice and a dozen ship's biscuit.

Breakfast and the long morning passed without any sign from the Sultan beyond the raising of the Union Jack above the palms. Chagrined and annoyed, we passed the hours watching the native divers—magnificent black Tritons—bring up small coins from the bottom. They disdained all but the silver coins, which they melt to make gewgaws for the women. Socotrans have no use for money among themselves, though they can make use of it in their dealings with Arab traders.

WELCOMED BY THE SULTAN'S NEPHEW

In the afternoon, when the sun had somewhat abated, our party went ashore. A great gathering had assembled; hardly a man on the island but was there to meet us, saving only its lord. On the fringe of the throng and lurking shyly among the trunks of the palms were even a few women. Not many of them had seen a white face before. They crowded to survey us, and a nephew of the Sultan presented himself with many salaams and excuses. His Highness had a slight indisposition and was sojourning at his summer house in Haulaf, some eight miles away. Undoubtedly he would come tomorrow. Meantime, on behalf of his

Photograph by Charles K. Moser

FRANKINCENSE BLOSSOMS AND FRUIT

royal uncle, he presented us with the island and all it contained. The nephew was a big, upstanding, coffee-and-cream colored Arab, with a great scimitar of a nose and fine bushy whiskers, which he continually stroked with loving pride. He carried a superb jeweled sword that must have been a gift to the kings of the frankincense country from some Maharajah long ago.

Hadibo, or Tamarida, as the Arabs call it, from *Tamar*, the date-fruit tree, is a collection of flat-roofed white houses scattered among the palms. The Sultan's "palace" is a large mud structure with flat towers, and the two prayer houses are suggestive of the graceful Arab mosques only by contrast. The poorer population, chiefly of African descent and much older in the history of the island than its Arab aristocracy, lives in huts of thorn and plaited grass, invariably overrun with luxuriant gourd vines. Surrounded by tiny garden plots, in which tombac, or native tobacco, lentils, melons, and yams grow abundantly, they are more picturesque outside than inside.

There is not much to be seen in Hadibo. The principal amusement afforded the visitor is that of being seen; one is fortunate if any part of his person or belongings escapes much handling, as well as the sharpest kind of scrutiny. Yet they are a kindly folk, hospitable and quite harmless. Quarrels among themselves are said to be almost unknown.

THE LEGEND OF THE SIRENS OF SOCOTRA

They took us into their huts and showed us their few poor possessions—a primitive loom, a quern for milling grain, many unglazed earthen pots oddly striped with dragon's blood, some goatskin bottles to hold *ghi*—with none of that air of mingled resentment and loftiness affected by the Arab at such times. The women for the most part kept shyly veiled, or crowded behind the doors, while the men brought out their small stores of skins, dried tombac, lumps of frankincense, and aloes for our inspection. It is said that in ancient times the Socotran women exercised the arts of magic, and among the Arabs the legend still survives that they

Photograph by Charles K. Moser

PHOTOGRAPHING THE LEAVES AND FLOWERS OF THE FRANKINCENSE TREE

One variety of the Dragon's Blood is the tree seen in the middle, with two frankincense trees, *Boswellia socotrana,* right and left. The trunks are about 30 inches in circumference, the height 25 feet. They are growing in very rocky soil at an altitude of 2,800 feet.

were wont to sit on the rocks and lure mariners to disaster with their smiles. Possibly the Socotran women were the Circes and the Sirens, so fatal to the old Greek sailors; but if so, their charms have sadly deserted them since, or the sailormen of that day were even more impressionable than sailors are now.

We returned from our visit to the capital along the banks of the *khor,* or lagoon, that winds its placid way through the palms. Strangely enough, a strip of sand not more than 50 feet wide divides its sweet waters from the brine of the sea. There are several of these silted-in lagoons along the coast, and that eminent traveler, the late Theodore Bent, thinks they are the remnants of ancient harbors in which the smaller ships of those times easily found shelter.

Nothing could be lovelier than the sight of slender Socotran cattle grazing knee-deep among the grasses and the palm branches that line the banks of these khors. Clouds massed above and mountains near behind; long shadows dappling the water, and the sun turning to gold the tawny flanks of the cattle makes a picture of pastoral beauty rare to behold in this part of the East.

THE SULTAN'S DELIBERATE AFFRONT

By the middle of the next afternoon it was apparent to every one that the Sultan's continued "indisposition" was intended as a deliberate affront. He had no intention of receiving us. The thing seemed inexplicable, as Socotra is under British protection, and the Sultan, as the recipient of a bounty of 350 dollars a year, is liege to the British Resident at Aden. Nevertheless, there it was; such an affront as official dignity could not dare overlook in this ceremonial East. Worst of all, it was quite impossible for the party to attempt its camping trip in the mountains without the Sultan's aid. He had been notified of the visit weeks before, and we had expected him to meet us with camels, carriers, sheep, and all the impedimenta required for such a trip. We found nothing ready and our host supremely indifferent. Reluctantly, General Bell ordered our whole adventure to be abandoned and the captain to weigh anchor.

But for many months I had been endeavoring to get to Socotra to secure some frankincense trees for the Bureau of Plant Industry at Washington, and all my hopes of success had been centered on this trip. I knew I should never have a like opportunity again. As the result of my urgent importunities General Bell generously consented to keep the ship in harbor another 24 hours while I made a quick bolt into the mountains to find my trees, if possible.

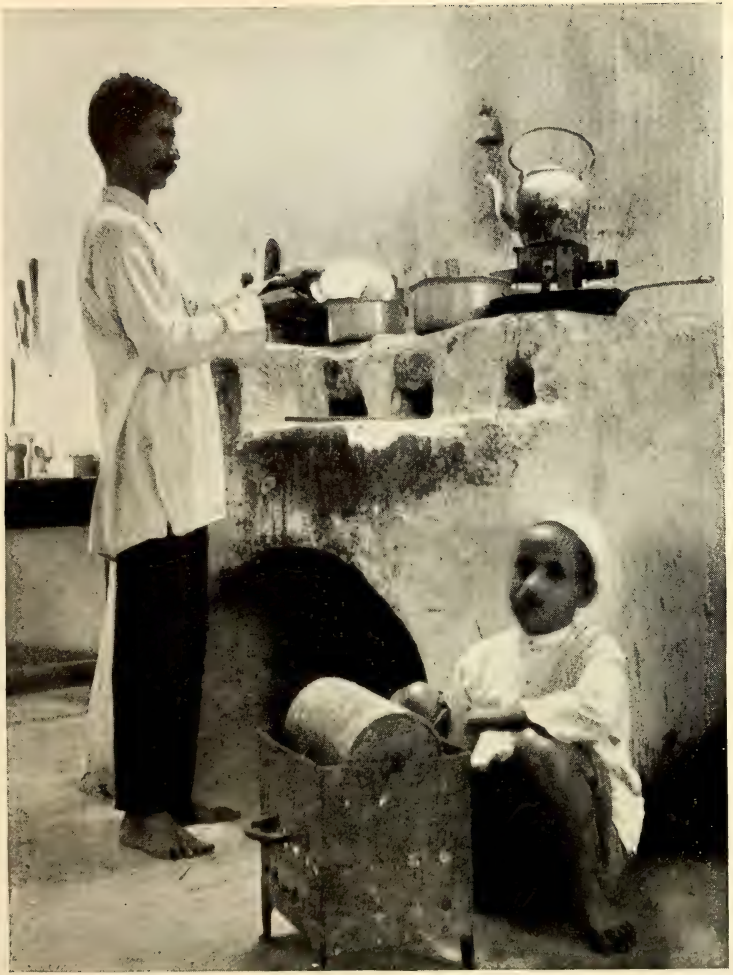
Twenty-four hours is very little time in which to penetrate a mountain wilderness and bring back any sort of game, especially a rare tree, but there was no choice, and some quick action was necessary.

BLOWS AND HONEYED PROMISES FOR THE ARABS

Captain Arthur Mitchell, of the Royal Garrison Artillery, at Aden, elected to accompany me, and Major Jacob hurried his invaluable interpreter, Ali Hussain, off to find us camels and guides. An hour later we were ashore with all our baggage and provisions. By the aid of a tongue that fairly dripped honeyed promises of "baksheesh," and ship's biscuit, Ali Hussain had assembled a small regiment of camels and donkeys and their drivers.

Bedlam ensued. Each man wished only to throw the smallest parcel he could find on his beast, rope it and sneak away. There were not even enough parcels to go around. The Sahibs were a golden harvest, sent by Allah, for the especial enrichment of camel men. Ali was everywhere, bestowing here a kick, there a smile, and sometimes both together; but without the aid of Major Jacob, a master of the Arab and his vitriolic speech, I doubt if we should have ever got started.

In the end, our relatively small amount of baggage, servants, guides, drivers, and interpreters were bestowed upon six camels, five donkeys, and twelve men! It was an enormous robbery, but the Socotrans had a complete grasp of the situation. Our head guide, a fat Arab rascal, who had not felt a rupee in his hand probably for a year, demanded 15 rupees, or about $5, per day for himself and his servant! He got it, too. Yet



AN ARABIAN KITCHEN AT ADEN: COOK AND BOY ROASTING MOCHA COFFEE

THE AUTHOR, THE GUIDE, AND HIS CAMEL MAN WITH THE YOUNG FRANKINCENSE TREE

Photographs by Charles K. Moser

these were the same people who had preferred a handful of rice to a silver dollar only two days before.

Our caravan had scarcely cleared the khor and got well on to the three or four miles of fertile, scrub-covered plain which divides the sea from the mountains, when the guide proved his mettle by suggesting that we camp there for the night. He had been made to understand clearly that his whole business was to bring us into the frankincense country at a point where we might be sure of securing some little trees that could be carried back to the ship, and he had glibly promised to introduce us to those trees by the middle of the next forenoon. Now the promises were so glibly renewed that my mistrust of him became certain and, much against his will, he was forced to push on. Even so, it was after sundown when we reached the glen behind Hadibo, where the Wadi Motaha broke a way for us through the solid wall of Haghier.

AMONG THE BEDOUIN CAVE-DWELLERS

The trail up the narrow gorge of the Motaha, worn by camels' feet and the torrential rains, is narrow, rocky, and exceedingly steep. In places it is scarcely wider than the width of one's beast, and the great thorn bushes beside it tear with insatiable claws at flesh and clothing. Flowers—yellow, blue, and crimson—some familiar, but most of them strange, and creeping vines over low trees gave the whole jungle the appearance of a lovely, unkempt garden—like a woman with disheveled hair. Occasionally one encountered the hideous cucumber tree, with its swollen and whitish stems, looking like enormous candles which had guttered horribly. This tree grows nowhere else, and the rest of the world is none the worse for it. Its proper foliage consists of a few tufts of leaves, with little yellow flowers at the top of its knobby branches; but we saw vultures roosting in nearly every tree and they seemed its fitting fruit.

After dark, when we were perhaps 1,000 feet up, lights appeared in the faces of the cliffs. These were the bedtime fires of the Bedouin cave-dwellers, who live on nothing but the products of their herds. They are a folk so timid that we caught no more than two or three glimpses of them; but we heard their shepherd calls in the morning, and all through the night the lowing of cattle and the bleating of goats betrayed them.

At 10 o'clock, when we had been climbing on foot and dragging the animals up after us for some three hours, tired nature refused to be longer denied. We made camp on a partially bald knoll, littered with mounds and ancient gravestones, near a place called Dahamis. While our Indian servants put up the tent under a spreading euphorbia, the men of Socotra ate a few handfuls of dates and rolled themselves against their prostrate beasts to sleep.

AN ENTRANCING SCENE

We were now about 2,000 feet up. The air was deliciously cool and toward morning it became even biting. Through the tent flap one could look down upon the whole valley behind us, bathed in a heavy dew. Eight or ten miles away the sandhills by the sea glistened in the full moonlight like mounds of silver; nearer, every leaf and stem in the scrub stood out in black and silver filigree; euphorbias and adeniums, gouty and pompous above the scrub, seemed like the fantasies on a Japanese screen. The whole landscape was a series of wonderful traceries in moonlight and shadow, entrancingly lovely.

With the dawn we were scrambling up the slopes again. Animals and baggage were left behind as useless. Guns were even discarded; the wild goat was free to kick his heels in our faces, if he liked, with perfect impunity. I, at least, was obsessed by the one idea to get my trees and get them back to the ship by the time I had solemnly promised.

We were now in a region of much larger trees, many of them very curious and all of them strange to me, except one which resembled, and most probably was, a species of the African baobab. Most interesting of all were three species of the famed dragon's blood—whose ruby-red fluid was used to dye the robes of olden queens—which stood all about us on the slopes, like battalions of skirmishers half hid in ambush.

The natives call these trees *A'ara-eeib*

Photograph by Charles K. Moser

SHEIKS OF THE SOCOTERI: THE LARGE-BEARDED MAN IS THE SULTAN'S NEPHEW

and their resin *M'soilo*. In ancient times Socotra was known as the only home of the dragon's-blood tree, but nowadays Sumatra and South America furnish the world's supply. It is rarely used as a dye now, but chiefly in the preparation of varnishes. The Socotrans themselves employ it principally for streaking odd designs on their earthen pots.

HOW THE FRANKINCENSE RESIN IS GATHERED

The guide, ordinarily a taciturn man, had been discharging a rapid fire of jargon, more than Greek to me, for some moments, when my nostrils suddenly caught a thin but rich balsamic fragrance in the air. We turned a few yards off the path and the guide, who had been frantically trying to prepare us for the moment, waved a triumphant arm:

"Tee-leé-ah!" he exclaimed. . . .

We were in the presence of what was undoubtedly a tree, but it looked nearly as much like an enormous sea-serpent in the act of shedding its skin, so awkwardly contorted and alive it seemed. Tiny, whitish peels clung loosely about stems and bole of a peculiarly livid, blotchy hue. The woody fiber of the tree, distended with its viscous sap, was like nothing so much as decomposing animal flesh, and even the few bright red, geranium-like flowers on short spikes and the sparsely scattered tufts of sumac-like leaves could not soften its repulsive aspect. But it was indeed the frankincense tree we had come to seek, the *tee-leé-ah* of the Socoteri, the *olibanum*, or *al-luban* of the Arab, and the *Boswellia socotrana* of science. The fragrance hanging all about and the partially dried, resinous "tears," exuding from wounds in the bark made by insects, testified to its nature.

The guide, proud at last in the virtue of accomplishment, gathered us about him to drink a bowl of goat's milk and learn how the natives gathered *luban*. The process is simplicity itself. About a month after the rains begin, say in June, when the tree is swollen with sap, the Socotran gathers his household about him

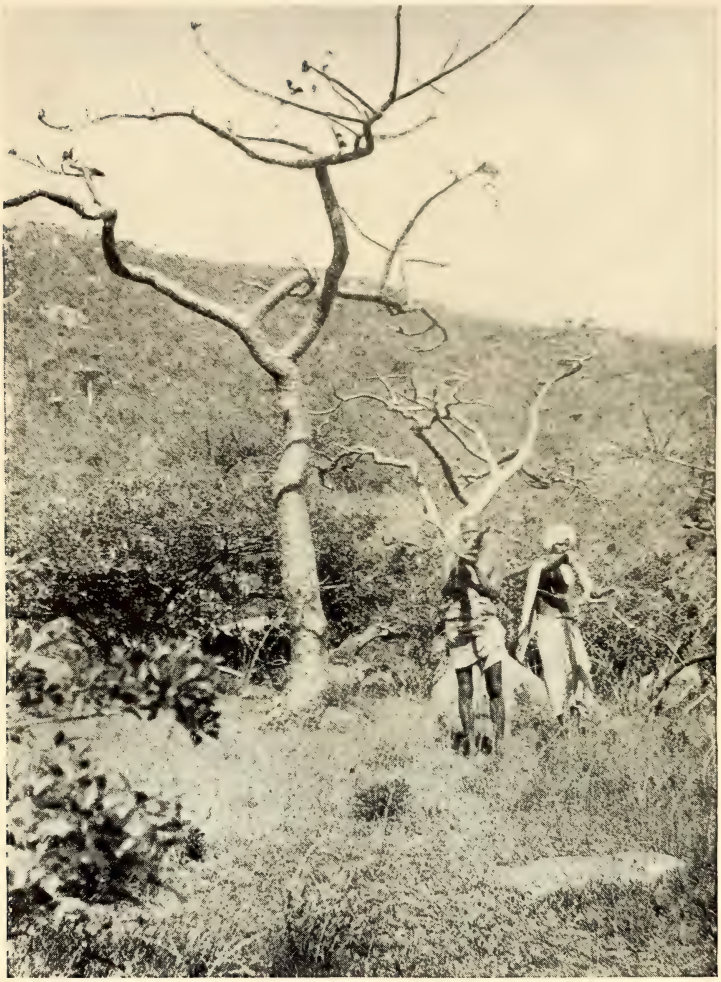
Photograph by Charles K. Moser

THE "GOGGLYWOGGLE" (SEE PAGE 268)

and they go among the wild trees which tradition has allotted him as a family inheritance. Each tree is given ten or a dozen deep, oblique slashes two or three inches in length, and a wrench of the knife tears the lower end of the wound open to form a kind of pocket. In these pockets the amber-colored or whitish "tears" of resin collect, hardening slowly. At the end of a month the collector returns, rips out the partially hardened resin with the point of his knife, and makes more wounds in the bark. He repeats the process once a month until the end of September.

As soon as the *luban* tears are hard they are ready for the market, and they are usually bartered to an Arab trader for kerosene or cotton cloths from America. A tree in Socotra will produce annually about 8 pounds of *luban,* worth 10 cents a pound; a Somaliland tree will produce twice as much and of a quality twice as valuable.

This was all very fine; but as it was now nearly noon and all the frankincense trees in sight were 20 feet high and from 8 to 10 inches in diameter, I told the guide to hurry along and bring us to the little trees which we could take back to the ship.



Photograph by Charles K. Moser

A TYPICAL SOCOTRAN FRANKINCENSE TREE

"Why, Sahib," he exclaimed innocently, "these are the ones."

"Yes, yes, idiot. But where are the *little* ones?"

"FRANKINCENSE TREES HAVE NO YOUNG"

Such an expression of mingled astonishment and rascality came into his face: "Sahib, there are no little ones. Frankincense trees have no young!" . . .

When it was made plain to him that this answer had not appeased the Sahib's wrath, he sullenly explained that smaller trees were no nearer than two days' journey beyond the next pass. Diligent search of the adjacent slopes convinced us that he was at last speaking the truth. There really were no small trees to be found in the whole gorge. The scamp had deceived us from the very start.

We were now about 3,000 feet up, 15 miles from the ship, and it was past noon. There was no time to go any further. I called the nine camel men together and promised a fat "baksheesh" to the man who brought me in a tree small enough to transport to the ship. Six of them did not display the slightest interest in the proposition, but the other three scampered away up the cliffs like goats. The rest of the party returned to the camp.

In about two hours one of the men returned with a tree 3 inches in diameter and 8 feet tall, which he had dug out of the hard red soil with his fingers. Half an hour later another came in with a smaller and better specimen. The third man we never saw again, as we lost no time in hurrying back to the ship. The two trees had to be carried all the way on the backs of their finders, as it became evident that if they were made part of the camels' burdens the thorns would destroy them. We reached Hadibo less than an hour late, but completely exhausted, and it was not surprising that howls arose from our followers for more pay and "baksheesh."

SOCOTRA'S EARLY CIVILIZATION

Aside from its strangely varied and odd vegetation and its bizarre scenic beauties, there is not much, perhaps, in this fertile, almost forgotten, island of Socotra to attract the tourist unless he

Photograph by Charles K. Moser

SOCOTRANS DIVING FOR COINS

be a student of ethnology. Old geologically, there are also still to be found in the ruins of Zoko, the ancient capital (Suk, the Arabs call it), traces of a very early civilization.

During our brief trip into the mountains we stumbled over four or five old burying grounds on the summits of easily accessible knolls, their flat and crumbling gravestones inscribed with what the traveler, Bent, declared to be Ethiopic graffiti. Christianity, undoubtedly of Abyssinian origin, gained an early footing in the island and probably survived, according to Bent, as late as the seventeenth century. Marco Polo and St. Xavier both report having found a debased form of Christianity among the Socoteri of their day. The churches have all disappeared under the intolerant heel of Islamism, but there are several ruined villages still remaining which the inhabitants point out as the work of the cursed Nazarines.

Though the word Socotra is supposed to be of Hindu origin, the old Greeks called it Dioscorides. Their ships visited it often for myrrh and frankincense, aloes, dragon's blood, and spices. Here the Greek sailors probably saw their "mermaids," too—the shallow Socotran bays are breeding grounds for strange sea creatures—and in their tales at home invested them with a beauty only possible to the Greek imagination. The two specimens of the manatee, male and female, taken in Socotran waters and brought to Aden are monstrous and horrible to look at, but startlingly half human, half fish.

Today Socotra exports practically nothing except *ghi*, a rancid butter, made from goat's milk and highly prized in Zanzibar. The inhabitants number about 5,000, and the bulk or them are of African descent, though Bedouins live in the mountain caves, and the ruling class is Arab. The language is distinct in itself, though possessing many Arabic and Mahri words. It has a wondrous wealth of gurgles and impossible noises in the

Photograph by Charles K. Moser

OUR FRANKINCENSE CARAVAN GATHERED ON THE BEACH

throat. There are no words for horse or dog, because these animals are not found on the island. A fine breed of camels and donkeys, which are the tamed sons of the wild asses roaming in thousands on the interior plains, are the beasts of burden.

THEIR "TELESCOPES" MADE IN AMERICA

The Socoteri are for the most part a pastoral people, living upon their flocks and herds. They have neither inclination nor skill for the industrial arts. The baskets they weave and their earthen pots, fashioned with a bit of cocoanut rind in lieu of a potter's wheel, are rude imitations of the southern Arab's handiwork. Those who live by the sea catch fish or dive for mother-of-pearl. They have a most ingenious "telescope" for spying out the wonders that lie at the ocean's bottom. It is simply a kerosene oil can, "made in America," with a sheet of glass set into one side. Into the opposite side the observer thrusts his head, and with the glass bottom well down in the water he is rowed slowly back and forth, mouth and eyes well protected from the salt water, which further serves him as a magnifying lens.

Having got our precious trees aboard ship, we lost little time in getting under way for Mokalla, on the south Arabian coast. There the Sultan met us in a motor-car and took us to his electric-lighted palace, where he was given the presents we had intended for his brother of Socotra. The frankincense trees, planted in a large packing-case half filled with their native earth, are still alive and give promise of some day throwing their fragrance to the breezes of Arizona.

A UNIQUE REPUBLIC, WHERE SMUGGLING IS AN INDUSTRY

By Herbert Corey

Author of "On the Monastir Road," "Shopping Abroad for Our Army in France," etc.

IT WAS quite by accident that I found Llivia. I had started out on a hunt for Andorra, that joyous little republic on the crest of the Pyrenees which is trying to live up to its medieval traditions by making an honest living as a smuggler during the world war. It is not every day that one finds a cheerfully outlaw State in the midst of moderately innocent outlawry. In Barcelona stories were told of the flagrantly public leave-taking of the mule smugglers from the great square of Vieille Andorra, and of the narrow paths by which the contrabandists who specialized in tobacco made their way into France. A visit to Andorra seemed imperative.

I had never heard of Llivia. Not one guide-book in three mentions it. Those that do give it a slighting four-line paragraph as "a Spanish village in France," and further impair a reputation that has been blown upon for centuries by alleging that the principal trade is in articles of contraband. Its stern old church and the lowering little fortresses the Llivians believe are homes, and the narrow, winding alleys in which mounted men were once helpless against cross-bows do not attract tourists.

Tiny electric lights now make the Llivian night visible, and there is a telephone in the Bureau of the Guardia Civile, at the corner of the Plaza de la Constitucion. But these modernities do not impair Llivia's status. Even its enmities are of the seventeenth century. Its people do not permit themselves to forget that they are Spanish people in a Spanish town set down by the accident of an old war in the land of France. One reaches them by a neutral road.

Because the Andorran smugglers furnish the reason for this narrative and Llivia is but the incidental decoration, the story of Andorra should be told first. But I find it difficult to keep away from Llivia. There is something exquisitely anachronistic in this little town—it has but 600 people in all—whose men work in the fields by day and run loads of contraband into France by night. The hand of every officer of the law is against them. The neutral road by which one reaches Llivia from Spain is guarded by two posts of French and one of Spanish soldiers.

VISITORS REGARDED WITH JUSTIFIABLE SUSPICION

Strangers who wish to visit Llivia are regarded with a justifiable suspicion. When the carrier's cart in which the Spanish mails are carried jolts down the road, the bell on the neck of the fat old horse jingling merrily, the soldiers look into the cart and poke inquisitive fingers into packages. It seemed to me that the Llivians do not smile as do the cheerful Catalans on the one side or the French people on the other. They regard one dourly from under drawn brows.

But it is necessary to make a start for Andorra.

I left Barcelona, then, at six in the morning, the one hour of the day in which sleep seems desirable in this gay city. At 7 o'clock the rag-pickers begin their noisy rounds in the little donkey carts from which the "La Defensa" flag of their union floats defiantly to the breeze. By 9 o'clock the sellers of lottery tickets are in full cry. At 10 o'clock the *ramblas* are full of people, who gossip as they walk between the bird markets on the one hand and the flower stalls on the other. Many pretty girls, clad in the lightly floating costume suited to the Spanish summer, appear by noon, and from 1 o'clock on all Barcelona eats as

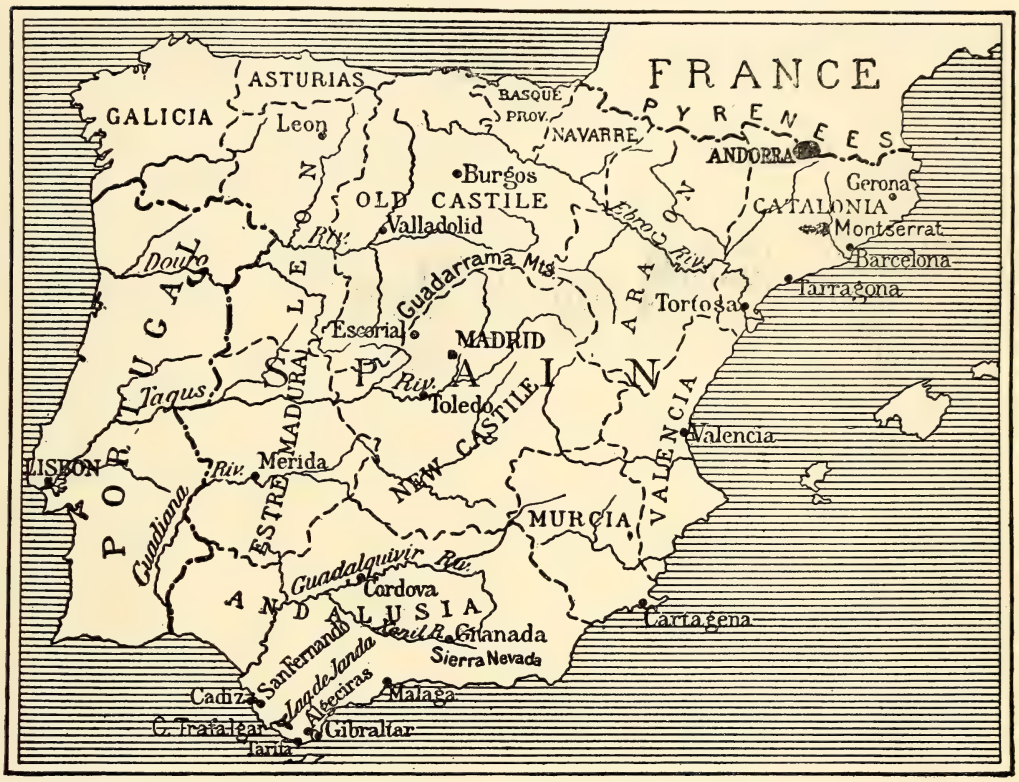
THE START FROM SEO D'URGEL FOR ANDORRA

though eating were a rite. The revolutionists fill the streets at 5 o'clock and the government is freshly torn down with each fresh edition; and from dinner time until that hour in the morning when the last reveler nods sleepily to bed, the café concerts thump and squeal, and trams rattle and taxis hoot, and an unending stream of blind operators upon instruments of music stops before the restaurant terraces while their maimed agents clash coppers in little pans. The pan, it appears, serves as a cash register. The clank of a copper in the tin never fails to register on the sensitive musical ear, no matter with what fervor its owner may be attacking a difficult harmony. Decidedly, 6 o'clock in the morning has its somnolent attractions in Barcelona. It is cool then and the streets are wide and empty, and quiet comes to one as a balm.

TRAVELING IN THE SORT OF CART IMMORTALIZED BY DON QUIXOTE

At Ripoll a carrier's cart, of the sort that was cursed and immortalized by Don Quixote, waited. It had the body of a prairie schooner swung on two wheels, while beneath the axle a net carried such baggage as could not be thrust upon the laps of the passengers or roped on the conveyance somewhere above the water line. We climbed in through a gate at the rear and sat facing each other, eight of us, all knees rubbing and all voices going at once. Later on the trunk of the boy who lived in Andorra and was on his way home from his first venture in the world was tied across this gate. Then we climbed in and out of the front end by clinging to the shaft and the harness of the rightfully dissatisfied wheel mule.

One was compelled to sympathize with this cynical beast. He did his part—one would say that he overdid his part—and certainly tugged quite as stoutly as did either of the horses that led the caravan. But the old man who drove the cart had two whips—one for the horses and one for the mule. The horse whip was a long and ornamental affair, with which he flicked at the rumps of the lead team; but the mule whip was a short, stout, business-like bludgeon, with which he battered that unfortunate. When the



SKETCH MAP OF SPAIN, SHOWING LOCATION OF ANDORRAN REPUBLIC ON THE FRENCH BORDER

whip-popping and the shouts which accompanied failed to stir the leaders into action, it was the old man's habit to lay aside his reins entirely and whack the mule until the noise startled into action the team ahead. One agreed with the mule that this seemed hardly fair.

From time to time the items of the human cargo changed. The home-coming boy, who had worked in a restaurant in Seville, was distressingly inquisitive. He had a few words of French, and kept at me until he had extracted every bit of information that our joint vocabularies could convey. Then he told the others.

His round, china-blue eyes stared unwinkingly during the eight hours of our cart companionship, but what he missed in courtesy was more than atoned for by the other passengers. Not one gave me more than a glance on entering, though they listened to the boy's story with grave attention. A girl insisted on sharing a basket of fruit, and a bent old peasant woman on her way to work in the high fields, a leather bottle across her knees and her wardrobe in a pathetic little basket, helped to find lunch in a wayside inn. The pretty daughter of a hidalgo of the countryside pointed out the views that were revealed at each turn as we climbed the pass.

A MOUNTAIN COUNTRY RESEMBLING COLORADO

For the better part of sixty kilometers to Puigcerda, we drove through a mountain country familiar in every gray hill and green valley to one who knows our own Colorado. Sheep dotted the landscape, and the narrow meadows were farmed to the last inch. Now and then a golden ribbon wound about the dark shoulder of a hill where grain was being harvested. A terrace had been built there and fertile earth carried in baskets and the water from some overdaring spring coaxed to vivify it. Some of these little hillside fields seemed no wider than a cradle blade is long, and wandered in

Photograph by Herbert Corey

THE CITY OF ANDORRA, SHOWING TERRACED FIELDS ON THE MOUNTAIN SIDES WHICH OVERHANG THE TOWN

CHILDREN OF ANDORRA REPUBLIC, SPAIN

Photograph by Herbert Corey

THE PORTALS OF THE HOTEL DE VILLE, ANDORRA

The arms and the Republic's motto, "Domus Concilii, Sedes Justicias," are above the door. The horses of the 24 councilmen are stabled on the ground floor when they meet. The deputies sleep, eat, and cook their own meals on the second floor.

the most decorative fashion along rocky slopes that seemed hardly fit for sheep pasture. It was as though a mural artist of the Titans had painted garlands on the canyon walls.

The carrier's cart jolted into Puigcerda through a country that might be France, except that a political accident made it Spain. Mountains hem in the little valley in which this old town stands. The trees were of that gray green to which one is accustomed across the border. The sound of running water fills the land. Everywhere little rills prattle down from the mountains and are trapped in irrigating ditches and tinkle away over stones and under overhanging tufts of sod in the most friendly and intimate fashion.

At first one wonders at the work that has been done upon this country, in comparing it to some portions of our own barb-wired and clapboarded farming States. The fences are boulder walls and the houses are of heavy stone; the irrigating flumes and larger canals are of rockwork that would almost withstand an earthquake and are concreted against the loss of a single drop. Then one recalls something of history. Men have been at work on these farms for more than thirteen hundred years. There was a bishopric at Urgel, the next stop after Puigcerda on the road to Andorra, in the sixth century, and the same bishopric is still there. Puigcerda was the capital of the land of Cerdagne more than a thousand years ago. There is a marble tablet in the old church which tells of the burial of a well-loved lady in 1310, and Puigcerda and the church were gray in age even then.

WOMAN AND DONKEY TOIL TOGETHER

At first one looks with a wholly American contempt on plowing done by oxen and marketing in which an old woman collaborates with a panniered donkey; but this gives way to respect. The farmers here make their hay with wooden forks cut from a conveniently molded sapling. After the mules have trodden out the grain they toss the wheat into the air from wooden shovels for the wind to winnow it, just as the Moors did before they were driven out of Cerdagne. The

Photograph by José B. Alemany

THE BYZANTINE CHURCH OF SANTA COLOMA, ANDORRA REPUBLIC

plows never have more than one handle and are sometimes mere crooks of wood shod with iron. But the sheaves piled high in the fields told of an intensive cultivation that has only made these fields more fertile in the centuries of use.

I had already learned there are two sorts of Spaniards. At Barcelona one is asked if one speaks Castilian or Catalan. At Puigcerda my national pride was somewhat abated by the discovery that there are two sorts of Americans. I sought to negotiate with the soft-voiced girl in the shop nearest the hotel for some postcards. A question revealed my status.

"Mother," she cried. "Mother, here is an American."

Mother came from the dark rear of the little establishment and smiled in a pleasant and wholly friendly curiosity. At first she was incredulous. Upon listening to the disjointed conversation she made known the reason for this skepticism.

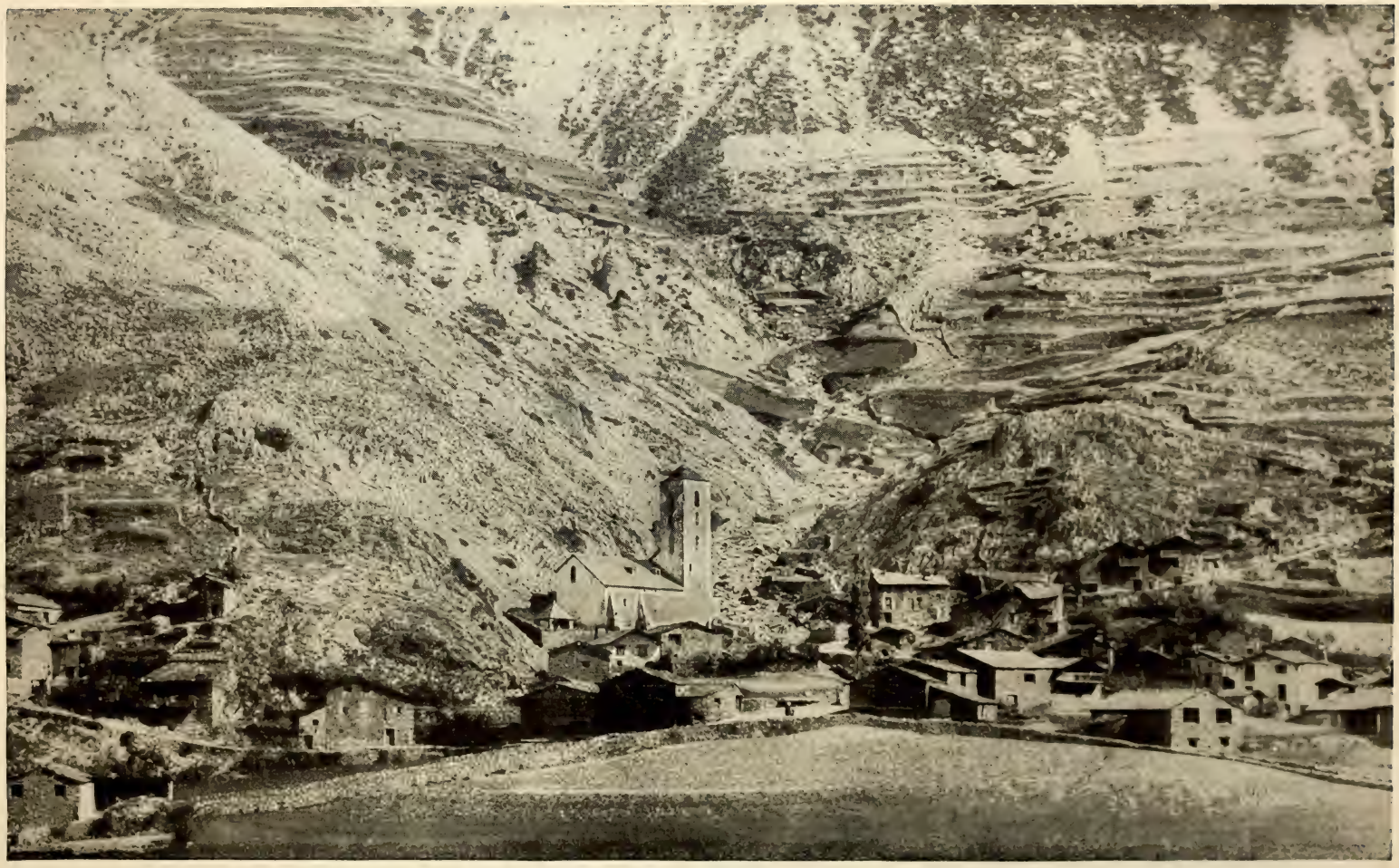
"The stranger," said she, "is a Frenchman. Does he not speak French?"

"He is a North American," the daughter explained.

It was most flattering to have my French accepted at its face value. Heretofore it has only passed current among the graduates of schools of languages. Perhaps my heavy buying of postcards gave the girl a clue to my habitat, for she asked me if I had ever been in New York. Upon the admission she fairly beamed.

"I have something here from New York," said she.

She delved under the counter and produced a pasteboard box in which cartridges had been shipped by a firm in New York State, and pointed out the name to me in real pride. We turned it over and over in our hands as though it were a curio. She seemed to have kept the box in much the same spirit in which our grandmothers once kept the lacquered packages in which tea had been shipped from China.



Photograph from José B. Alemany

CANILLO, ANDORRA'S NORTHERNMOST TOWN: ALL HOUSES ARE BUILT OF STONES

Photograph by Herbert Corey

THE CARRIER'S CART IN WHICH THE START WAS MADE FROM RIPOLL, SPAIN

Photograph from José B. Alemany

BRIDGE AND CANYON OF SANT ANTONI, ANDORRA

It is said that on this bridge Charlemagne and the Count of Urgel signed the treaty of the liberty and privileges of Andorra

But the old lady was not satisfied. She had been revolving apparent discrepancies in her mind, and when I left she asked another question:

"Do the North Americans also speak English?"

SPAIN DRIPS WITH SPIES

In war time one wanders in Spain without the annoying formalities of travel in the belligerent lands. It is difficult to get into Spain, and much more difficult to get out, for the country drips with spies, and Spain's neighbors are insistent as to the credentials of travelers. Inside the line one wanders as he wills. An occasional visé from a police official is all that is required, and the police are even willing to abet mild errancies. It was from the host of the Hotel Europe that this was learned. Llivia's existence had just become known.

"It is difficult to go there, you understand," said he. "It is a Spanish village, true; but it is inside French territory, and the French do not like to have strangers go there. It is true that one goes there by a neutral road."

The situation seemed difficult, but Catalan kindness conquered it. If the host of the Hotel Europe seems singled out, it is only because he is typical of all other Catalans with whom I came in contact. I was traveling without other visible luggage than a camera. My pockets bulged disreputably with the various necessities of life. I entered his hostelry filmed with dust after eight hours in a mule cart, and yet he went to infinite pains to aid me. With that fatuity that sometimes comes upon one, I tried to tip him. This is a public apology. It was he who solved the problem of getting to Llivia.

"I shall see the chief of police," said he.

These worthies contrived a plot against the laws of two countries. The chief wrote out a paper which, upon transla-

tion, seemed to be an asseveration in Catalan that I had long been favorably known to him as a resident of Puigcerda. The host of the Hotel Europe enlisted the carrier in the stratagem and drilled him in the story he was to tell. I was to say no word, for my pitiful incapacity in all tongues known in the Pyrenees would have betrayed me at once.

"The carrier will say what is necessary if the soldiers stop you," said the hotel keeper. "At the worst, you will only be inconvenienced for a few days."

A SPANISH TOWN INSIDE THE FRENCH FRONTIER

The chances of arrest seemed excellent, but they also seemed worth taking; for there is but one Llivia. Away back in the seventeenth century Spain paid for an unwise war with France by ceding 33 villages and the territory surrounding them to the stronger power. But after the Treaty of the Pyrenees was signed, Spain "rued back" on a part of the bargain. She yielded the 33 villages, as agreed on, but exempted Llivia on the plea that it was a town and not a village.

So for 250 years Llivia has remained a Spanish town inside the French frontier. It is Spanish in everything but location. The Spanish mails go there, and Spanish taxes are occasionally collected there, and Spanish money is taken, and there is a post of the Guardia Civile upon the public square. As one jolts down the neutral road toward Llivia in the carrier's cart, one could toss his hat on either side into France. The very water that runs in the irrigating ditches at the sides runs in French territory.

"The principal trade of Llivia," according to the guide-books, "is in articles of contraband."

At Llivia the stranger suffers from the unjust suspicion that he is an officer of the law. Elsewhere in Catalonia the people are friendly and of an American self-respect. The boy who brought the morning coffee at Seo d'Urgel shook hands affectionately when we parted. The carter of Puigcerda cheerfully perjured himself when the French soldier abandoned his midday drowse beneath a tree and came to look at me. The carter said we were friends, and later took the franc with which this divagation was rewarded rather under protest. He was understood to say that any one would do as much for a comrade. Everywhere one encounters the most open-hearted and open-handed kindness. But at Llivia one is watched sullenly. Too often, perhaps, smuggling confidences have been betrayed.

So, I wandered unhappily through Llivia's tortuous thoroughfares, conscious of this civic distrust. There was a little girl who was blowing with a hand bellows upon the coals in the bottom of what seemed an early form of the tailor's goose. Ashes spurted out of vents at the side, and the coals at last glowed a yellow red in the hollow of the pressing iron. All this was magnificently new to me, and I beamed upon the girl and prepared to take a photograph when a long arm stretched from a doorway and girl and iron were retrieved. Then a door that would have withstood a battering ram closed softly in my face.

A TOWN READY FOR A SIEGE

But perhaps this pessimism is general and is not confined to the unvouched-for individual. The windows are barred with thick steel. Sometimes these bars are set with knife-like spikes, the edges of which have once been sharp, to catch the predatory arm that sought to reach through.

When a housewife goes to the municipal fountain to draw water or wash the daily salad, she closes her great, nail-studded door behind her and locks it with a key that might weigh a pound or more. If the municipal pig bothers her too greatly, she may withdraw this huge key from her girdle and throw it at him, so that it clangs loudly on the uneven cobbles in the rebound from his dusty hide.

There are overhanging balconies from which an attacking force might be resisted, and slits in some doors through which the caller is inspected before the bars are drawn. One might say that Llivia could stand a siege today, if only medieval means were used against her medieval defenses.

Even the church seems fort as much as sanctuary. One long old wall is pierced by loopholes for archers and is bare of any other window. It is defended at the corners by loopholed bastions. One gains

Photograph by Herbert Corey

THE SPANISH YOKE

This cruel method of harnessing oxen, which makes it impossible for them to move their heads, has descended unchanged from Roman times

Photograph by José B. Alemany

ANDORRA LA VIEILLE AND THE MAIN VALLEY TOWN OF LES ESCALDES FAR IN THE BACKGROUND: ANDORRA REPUBLIC

Photograph by Herbert Corey

THE PUBLIC SQUARE OF LLIVIA

On the first floor of the house facing the square the mules are stabled, while the family lives above; in the bitter cold of a Pyrenean winter the arrangement has its advantages

entrance to the only vulnerable side, in which the great old door is set, by climbing a flight of steep stone steps, in their turn flanked by a tower which alone remains of the original defensive works.

The courtyards, in which oxen are kept under their owners' windows, much to the injury of the village sanitation, are thick-walled inclosures whose gates are great affairs of plank, well barred against aggression, and always overlooked by a window from which they can be defended. The town breathes age and a state of arms. One learns to look with distaste upon the parvenu Café del Progreso on the Plaza de la Constitucion. It is a mere newcomer, this café, with its date of 1791 carved above the lintel. It is only when one learns this marks the time of its reconstruction that it is received into favor.

LIFE OF LLIVIA CENTERS UPON THE PUBLIC SQUARE

It is upon the public square that the visible life of Llivia centers in the daytime. Now and then a wanderer called at the Café del Progreso for one of the mild and sugared drinks to which the Spaniard is partial. A man shrouded in a great cloak and wearing a wide black hat pulled well down over his eyes passed and repassed. He had been a cart passenger and the carter had quite gratuitously assured me that he was a traveler in commerce. He was the breathing image of an operatic conspirator.

A small boy led a pig by a cord attached to a foreleg, and at intervals graciously permitted other small boys to hold the cord while he instructed them in the technique. A yoke of oxen swung slowly by, hauling a cart piled high with hay. But of the male residents of Llivia nothing was to be seen. If one smuggles by night, it is to be assumed that one sleeps by day.

The town crier was making his rounds when we returned to Puigcerda. He seemed as wholly out of date to an American as though a megatherium had been found strolling through these placid streets. He was an old man, most leisurely in his movements, and with an ex-

pression of confirmed melancholy. At first I attributed this to his knowledge that he was out of the modern picture. At intervals he blew a long brass horn, fishmonger style, so that I was entranced by it and followed him.

I had been watching the rope-walk under the eaves of the church, where an old man walked slowly backward all day long, a wad of hemp fastened to his girdle. He spun rope yarn from the spindles that were whirled by the belt from a wheel an irritated small boy turned. Later he twisted the yarn into rope in the same fashion.

The crier had not recognized at all that the time had passed for his leisurely method of diffusing information. When we reached the public square of Puigcerda, where a crowd waited the autobus that was to carry us to Seo d'Urgel, it became evident that his dejection had been occasioned by the lack of a proper audience. To the stranger and to the curious small boy who had trailed the stranger he had mumbled at intervals—always preceded by a stirring blast upon the trumpet—that a thrilling film of the life and adventures of Cristoforo Colombo was to be presented that very evening at the municipal theater.

AN ART IN TOWN CRYING

But in the presence of the throng in the public square, before that Hotel de Ville that was built in 1400, and which still bears the half-obliterated wheat sheaves of Puigcerda's arms on its walls, he became a different person. He registered emotion, as a movie man would say. His voice soared until it reached an oratorical climax, and then dropped to low and thrilling tones as he dwelt upon the pathos of this marvelous film. We who waited fairly hung upon his words. There is an art in town crying.

With every revolution of the wheels of the autobus toward Seo d'Urgel we moved farther toward the days of the Knight of the Mancha. Oxen began to wear fringed and beaded veils upon their patient faces. Men came down from the hillside farms, driving before them donkeys on whose pack-saddles were racks resembling five barred gates on which

Photograph by Herbert Corey

THE NEUTRAL ROAD TO LLIVIA

The wall at the right and the water which chatters in the stone-lined irrigating ditch at the left are in France, but the road is neutral.

wheat sheaves were tied. Wheeled vehicles are current only on the main roads. Pack-mules jingled with bells and wore heavily brassed saddles on which every form of package was securely roped. The authentic diamond hitch was in use everywhere, so that one saw where the art of our Western packers was born. Chains stretched across the roads at the posts of the Guardia Civile stopped traffic for examination.

On the hilltops are the remains of castles and fortified farms, reminders of the days, not so far distant, when each man took what he could and held what he might. The twin inventions of repeating firearms and the Guardia Civile have made rural life in Spain fairly safe now and the bandit no longer roams upon these roads. Nevertheless, the passer-by sometimes carried a rifle in the crook of

Photograph by Herbert Corey

A RAG-PICKER AND HIS CHARIOT FLYING THE "LA DEFENSA" FLAG OF THE RAG-PICKERS' UNION: MADRID, SPAIN

his arm, and the priest, who later rode down from Andorra with me, indicated that the knife is still a ready solvent of difficulties.

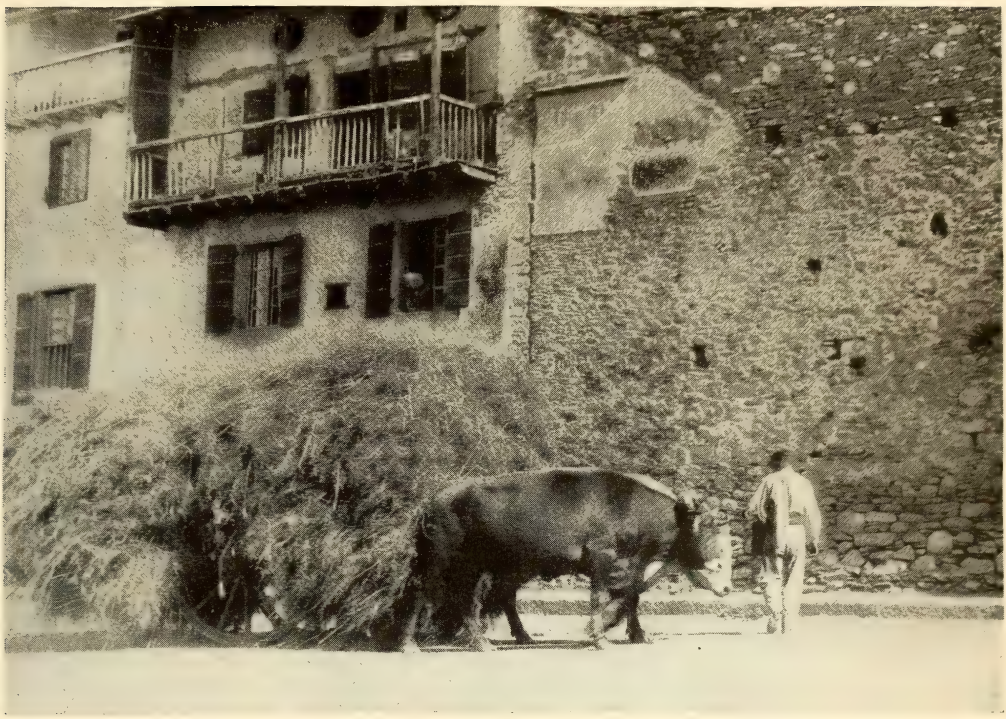
Perhaps I misunderstood him, as we talked by signs and scattered words, lacking any common language; but he shook his head sadly over the backwardness of his flock and pantomimed a dispute in the hills in most illuminating fashion. First the injured party shook a petulant forefinger at his antagonist; then there was an outburst of violent speech; finally the priest's hand flew to the belt of his black cassock, withdrew an imaginery knife, and thrust it so swiftly at my own girdle and with such a venomous air that I shrank coldly. He was a good priest, though. For slow miles he struggled with a statement until I finally made it out:

"AMERICA WILL BE THE FRIEND OF ALL THE WORLD"

"It is good," said he, "that America has entered the war. For all the other nations would seek to be masters if they won; but America will be the friend of all the world."

At Seo d'Urgel a temptation was resisted. The guide-books pay little attention to Seo—the country folk call it "Saao"—because it is off the beaten path. I had no time to explore it thoroughly. But certainly the "float," as a prospector would say, offered rich finds to the interested digger. There is a street of heavy, arched arcades, under loopholed walls, through which little streets pierce at intervals, which takes one back at a glance to the Middle Ages.

They are for the most part two men wide, these little streets. Some of them are roofed over, and dim lamps twinkle in their twisty lengths. They tell of the days called good, when men were killed fervently in them with axe and sword, instead of being scientifically entered upon the casualty list by cold-blooded mathematicians hidden miles away behind hills, and who would be helpless without their books of logarithms.



Photograph by Herbert Corey

A BUSY SCENE ON THE PLAZA DE LA CONSTITUCION AT LLIVIA, THE SPANISH TOWN IN FRANCE

The open doors of the shops afford glimpses that tantalize the stroller. Shopkeeping in the bishopric of Urgel seems to run largely to the sale of pack-saddles, coils of rope, and firearms, and the fragrant scent of leather comes to the nostrils. It was just opposite the great pots built in a stone oven under the arcade, from which bean soup is served to travelers on market and feast days, that I encountered the temptation.

THE SHOP OF SKIN FLASKS

There is a shop there, a cavernous, dark, windy shop. The floor is clear of the riffraff of rope and leather that one sees in other business houses. In the farthest corner a single candle is screened against the draft from the open door, and its tiny flame casts long, moving shadows of objects that swing lightly from the heavy rafters. There was a mysterious similitude of life about these things. They were faintly recognizable. It was as though many of the common domestic animals had reversed their normal habit and had attached themselves flylike to the half-seen ceiling.

Then came enlightenment. These were wine sacks made of pig and goat skins, which by the art of their maker had preserved a horrible likeness to their original inhabitants. There was one small wine sack there—it had been the earthly integument of a tiny pig—that I coveted with all my heart. It swung in the breeze from the open door, the half light concealing the imperfections of its present and emphasizing the plump coquetry of its original state. Twice I walked past the door and twice I was redeemed from folly. A dusty wanderer whose solvency was only vouched for by the possession of a camera must have added to his handicap by the surreptitious fondling of a wine sack that uncannily resembled a little pig.

Many old costumes have disappeared from the Pyrenees. The men rarely wear sabots, and then only when they are at

Photograph from José B. Alemany

THE "SARDANA," THE NATIONAL CATALAN DANCE, IN THE CENTRAL SQUARE OF ANDORRA LA VIEILLE (ANDORRA THE OLD)

work irrigating. Their footgear is usually the rope-soled alpargatax. Some wear a wide sash, but the crowd-color is chiefly furnished by the velveteens, which, chosen for their wear-resisting qualities, have with age and patches taken on almost Turneresque hues. Now and then one sees the scarlet Catalan cap, which folds longitudinally of the head and falls over one eye in the fashion once beloved of sea adventurers. Only on Sundays and fête days do the girls don the short skirt and low shoes of the artist's peasant. For the most part the skirt is short for utilitarian reasons, and all beauty of line is destroyed by their clumsy shoes.

SMUGGLERS REAPING A GOLDEN HARVEST

Doubtless Andorra smuggles at the best of times. That is the conclusion I reached, at least, from the perfect openness with which every one discussed the free-trade proclivities of the Andorrans. One might have thought they were talking of the spring plowing or the price of lambs. And yet Andorran secretiveness has become a proverb in the hills. "Tell a thing to an Andorran and it is lost," is one form of this saying. Nowadays, with the neighbor France in the market for everything that Andorra can furnish, and too busy fighting to watch her douanes very carefully, the men of Andorra are reaping a golden harvest. Scandalous rumor has it that the Spanish frontier guards look with a certain complacency on the illegal traffic.

"I have a cousin who is a frontier guard," a man in Barcelona told me. "He says that if the war lasts another year he will retire. At ten dollars a mule, he is already rich."

The situation of this quaint little survival of lost ages favors this form of activity. The Republic of Andorra measures about 25 miles in one direction by 20 miles in the other, and is located right on the crest of the Pyrenees. It is as though the little State were a wedge driven in and dividing France and Spain at this point. Charlemagne gave the Andorrans a certain measure of freedom because of their services in the field. They streamed down out of their hills and helped Louis the Debonair fight the Moors, with whom, however, they had a very lively quarrel of their own. For that he gave them a franchise.

"IT IS A POLITICAL CURIOSITY"

Napoleon looked the little State over. "It is a political curiosity," said he. "It must be preserved."

Andorra has maintained itself as a political entity for more years than has any other republic in the world. The tiny State of San Marino, in Italy, vies with it in point of diminutiveness, but Andorra was hoary with age when San Marino was born.

It is not worth fighting for, and it makes no trouble that a few policemen would not quell. Nevertheless it is a real State.

Andorrans pay almost no taxes at all. Each year a small tribute must be paid to the Prince Bishop of Urgel and to the Republic of France, and a levy is made on the incomes of the Andorrans for the purpose. There are almost no other costs attached to the operation of the republic. Each of the six cantons in which the little State is divided elects annually four councilors, and the 24 select one of their number for president. They are paid a few sous each when they attend a meeting of the council. Their horses are fed by the State and they have their meals. Now and then the hall of the council needs a new slate on the roof. The annual budget stops there.

The carrier's cart left Seo d'Urgel when it was just light enough in the morning for me to see that my neighbors were all peasant women on their way to St. Julian de Loria, the first Andorran village one reaches and a famous resort of smugglers. Not so long ago a mere mule track connected Seo with the capital, but now a fairly good road follows the winding course of the torrent of the Valira. Coffee is not to be had out of hours at a provincial Spanish inn, and we were more than sharp set when the carter turned us out at St. Julian and made us walk up a grade the mules could not negotiate with a full load.

A FETE DAY IN ST. JULIAN

It was a fête day in St. Julian, it appeared. A stand in the public square, which was a mere bulbous enlargement of the cart road, had been decked with

Photograph by Herbert Corey

THE OLD ROPE-WALK: PUIGCERDA, SPAIN

greenery. A girl dressed in the fête-day costume of the hills—a white bodice cut modestly low, operatically short skirts, and low shoes—ran to meet the discontented little violiniste who had frowned on us and on her peasant mother from her place in the crowded cart. The violiniste was dressed in the cheap finery of Barcelona, with high-heeled shoes of poor leather, badly scuffed and run over at the heels, while around her neck she had wound a boa that had been built of chicken hackle. The sister was charming, but the feminine in her led her to admire the awful tawdriness of the violiniste.

"Thou art in grand *tenue*," I heard her say.

There was time to see that the public square was filled with men putting impatient feet against the ribs of rebellious mules in the effort to pull tighter the ropes of the diamond hitch. Loads were going across the hills, fête day or no. Other tired men straggled in at the heels of tired mules, the pack-saddles empty, after a successful trip into France. Small boys were importantly aiding. Girls clung to the arms of the *contrabandista*, and old women waddled about with parcels that looked like provisions for the departing. Then came the call to breakfast, and the smugglers were forgotten.

There were tiny trout served at this one *peseta* breakfast, and toasted bread and doubtful coffee; but the undoubted *pièce de résistance* of the table was an automatic fly-swatter that ran by clockwork, and which at least made the swarming flies respectful. Wine was served in the two-spouted bottles from which one pours the fluid at a distance into a thirsty mouth, and which are such a snare to the unaccustomed wayfarer. The old woman who was mistress of ceremonies hunted about behind the counter of the tiny store which was an adjunct to the inn and found a fly-specked letter-head.

"Thou shalt have this," said she. "It will serve to save us from forgetfulness."

All the way to Andorra I had cherished a secret hope that I might be permitted to accompany the smugglers on one of their illicit trips; but when I

reached the capital this vain hope was blighted. It was not that there was the slightest suspicion of a stranger, or that the march over the hills was considered too difficult for tender feet; but the Andorrans felt they must consider the state of the stranger if he were discovered in France without a proper visé on his passport. It was felt that he might have the greatest trouble to explain himself, and that in the explanation an official and undesirable attention might be directed toward themselves; so I was regretfully refused.

But the operations of the smugglers were made quite clear to me. In these Pyrenean hills a tobacco is raised by which the rankest Connecticut second growth might class as Havana. This frightful stuff is labeled in accordance with the tastes of the prospective victim. One may have a Havana cigar, or one ticketed from the Canary Islands, or marked Carolina or Virginia or Gibraltar. Even the revenue stamps are counterfeited, so that, so far as externals are concerned, the elect would surely be deceived. But an outraged palate would discover the deception.

In the tobacco factory of Andorra these cigars and cigarettes are put up in packages, and packed in haversacks which are just a load for one man. If the smugglers run a haversack through to France they are paid eighty pesetas. If they are forced to abandon the load en route they are still paid twenty pesetas. The packages of cigarettes which one buys for twenty centimes in Andorra sell, according to the stamp upon the package, for eighty centimes outside; so that the smuggling profit is not to be despised. But the most profitable trade is in mules.

CHIEF TRAFFIC IS IN SPANISH MULES

Spain has been fairly robbed of her mules by the needs of the Allied armies, and so the further exportation is frowned upon by the government. Likewise, although these mules are bought for the French army, France still maintains an import duty upon live stock. The Andorrans procure mules by hook and crook from Spain, and lead them over the hills at night by unfrequented paths into France. The share of the gendarmes in this traffic, as previously stated, is ten dollars a mule. There is no record that an Andorran smuggler has been recently injured in the practice of his vocation.

There is a prosaic stability about the business of smuggling in Andorra that detracts from its interest to the visitor. I turned my attention to the study of history in Andorra, but here I was somewhat disappointed. It was possible to get into the old council hall, in which the horses of the councilors are stabled on the ground floor, while the council hall and their sleeping quarters are on the floor above. There is a fine old fireplace there, in which the administrative meat is roasted, and a cupboard with six locks, in which archives are kept that date from the days of Charlemagne.

But each canton has a key, and the keepers of the keys were on the hills, smuggling or watching the cattle that furnish the most permanent source of income here; so that my inquiry into Andorra's past was a somewhat scanty one.

TITLES ONCE OBTAINED ARE NEVER RELINQUISHED

The total population of the republic is about 6,000, and those men that have arms serve in the army. There are no uniforms in the army, but this shortage is made up by the surplusage of officers.

Artemus Ward's regiment of brigadier generals might well have had its inspiration here. The man who once gets an office never relinquishes the title, and as offices seem to go somewhat by rotation, the untitled man in Andorra must be a poor stick indeed. Nor is there a finicky precision in the matter of arms for the army. The man who served lunch showed me with pride a blunderbuss made by Tower, in London, in the days of one of the first Georges, and assured me that he was a soldier in good standing. It was a good blunderbuss, too—clean as a watch and obviously up to anything. I did not wonder at the pride he took in it

"It is a hard country," said the priest who shared the mule cart on the way back to Seo. "The cattle begin to straggle down from the hills when the snow falls early in September. The winter is long and very cold and my people are so poor. But for the smuggling they would suffer. What would you?"

PLAIN TALES FROM THE TRENCHES

As Told Over the Tea Table in Blighty—A Soldiers' "Home" in Paris

By Carol K. Corey

Author of "From the Trenches to Versailles," etc.

ALL the long tables are ready for tea. The cloths are blue and white and so are the dishes. The milk pitchers are full to running over, the jam bowls too, and the large plates of fresh, sweet-smelling bread and butter are just where they ought to be. And there's cake—the good kind, full of raisins and currants and nuts. Why, there's even plenty of *sugar!* So, as I tie on my absurd little apron I say to myself that it doesn't look like a war-time tea at all.

But it is, in the fullest sense of the word; for in this big, cheerful, sunny room every guest will be in uniform. He may be a "Tommy," a "Canuck," or a "Scotty." If he's a New Zealander he'll call himself a "Pig Islander," and if he's Australian he's an "Aussie" for short. If he's French Canadian we never ask his name—just call him "Pierre," at which he smiles and shows his nice white teeth.

Never mind, he's a soldier on leave, else he wouldn't be in "A Little Corner of Blighty." Everybody knows that "Blighty" is just another name for Memory, or Courage, or Strength. Briefly, it's *home,* the beginning and end of the soldier's long, hard trail.

The first three to come to my table are "Kangaroos"—tall and straight, freshly shaven, uniforms brushed and pressed, boots of a dazzling brilliance; happy faces, happy laughter, happy hearts. "By these signs ye shall know them," for they are "just in."

"Just in" and what it means

To be "just in" means everything for which you have longed during twelve, fourteen, sometimes even nineteen or twenty months. It means *Paris,* with money in your pocket. It means freedom from discipline. It means *sleep in the morning.* If your pal's sharing your room, the last thing you say to him at night is, "Call me at six," *just* so you can tell him to "Go to," etc. Then you turn over again.

Often a glistening new alarm-clock is carried in, hilariously wound, and cursingly set for some unholy hour. And when it attempts to fulfill that mission for which all alarm-clocks were invented, it is sleepily but vigorously kicked into space to an accompaniment of "That sure was worth the price." It's nice to be "just in."

Before very long the three have learned the name of the best theater in town, and that of the finest and most expensive restaurant. The smiling one asks if the circus is still on, and when informed that it is he immediately decides for the other two:

"We'll go there tonight, though we're all pretty tired from the long ride down, and I suppose we *ought* to go to bed, inasmuch as we've got eight full days here. Indulgence leave, you know, only for good boys. And the best part of it all is that we're together. Two more 'birds' from our 'divvy' came to town day before yesterday, and we're all going to meet here. We've heard a lot about this little village and now we're going to prove it. Wright, here, didn't want to come to tea at all. Said he wanted to look 'em over. My word! The girlies are scrumptious in this old town. I'm saying to myself as I listen to your talk, dear friend, 'don't move; she might vanish'; for we haven't heard a lady speak English in seventeen months.

"Last night we saw a girl; she was plowing, and I don't mind telling you she got us going, at that. Wright hung out of

the car window and gave a good old Australian 'cooee.' But she just shook her head 'cause she didn't 'compree.' "

BARTY'S REQUIEM

Just here a fourth man wearing the same divisional colors on his sleeve joins our group to the gay shout of "Hello, Digger," which is only another name for "mate," you know.

Then: "Where's Barty? Didn't he come along with you?"

The newcomer shakes his head, and when he is asked "Why not?" answers simply, "Dead." To a further question of "When?" he replies, "Monday." And Barty's only requiem from three husky throats is, "He was a good bloke."

As I say "Hello!" to three New Zealanders, I see that something is very wrong with them, for they fairly radiate gloom—so much so that the smiling Australian, who has just lighted a "fag," again takes the floor. He wants us all to "gaze on this procession of joy-killers." And he goes on like this:

"Say, fellows, this is *'Parus.'* Don't you know that? And don't you know you're damn lucky to be alive?"

"That's no news to us," says one of the newcomers, a stretcher-bearer. "But on the last afternoon, when in spite of ourselves we feel a little down, we come in here and a lady begins to sing 'End of a Perfect Day.' "

When I look at these three nice boys facing no one knows what, in spite of all talk about "encouraging the morale of the men," I can't help saying:

"If you happened to steal another day, you wouldn't be the first."

The big-eyed one, who is a bomb-thrower, shakes his head mournfully as he tells me it can't be done, for "We've got to think of the other fellows who are waiting their turn. Anyway, it's a terrible risk."

THE UNBELIEVABLY PERFECT GIFT

And when I ask if the risk isn't worth the result, everybody present acknowledges vociferously that it is, but—at which the third kid, who up to now has eaten steadily and said nothing, breaks into the conversation with "Oh, hell, lady, we're three days overdue now!"

Some one touches me on the shoulder and I turn to greet a serious, anxious-looking soldier with whom I have a great secret. His first words are:

"Did you get it?"

And in a stage whisper I answer, "Yes."

Then he asks, "Is she pretty?"

And I say:

"*Wonderful*—really, truly curls and a white lace dress, and all the little underthings hand-made, with ribbon bows everywhere. And she can be dressed and undressed a hundred times a day, because there are regular grown-up 'snaps' on everything. Even her hat's got a hatpin and she's wearing gloves. And she says, 'Mamma' and"—

Here I am interrupted with, "Can she say *papa?*" And I swear it.

Having kept the best till last, I tell him that she *walks*. All you have to do is to turn a little thing in her back and she starts. She's so cunning I almost want to keep her for myself, though I shudder when I think about the price.

"*Price,*" scorns he, "do you think I care a hang about the price? Please remember that child o' mine is four years old now, and when I saw her she was exactly seven months. Don't you suppose I want her to know she's got a daddy?"

I take advantage of the lull in the rush of serving, and sneak him through the kitchen, where no soldier is allowed, into the room where we hang our coats. The chief tea-maker begins to expostulate, then recognizes my companion and only smiles; for she, too, has seen Miss Dolly. I allow daddy to open the box. As he lifts from the many sheets of pink tissue paper this unbelievably perfect gift he only gasps, "Oooooohhhhh," but I am repaid.

"WAR'S A GOOD THING FOR A LOT OF US"

I return to the tea-room to find a hot-headed chap storming indignantly:

"There you go again, talking about the war. There ought to be a law"—

"That's so," interpolates his neighbor. "What else do we know after three years of it? You pick a nice, new, interesting subject and tell us about it. Why not give us a little lecture on the *mud?* That's always interesting to the ladies.

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WHAT BLIGHTY MEANS TO OUR BOYS

The sailors on leave from their ships and the soldiers from the trenches bring to the city their high-hearted, indomitable youth and the motto, "This is Paris, and we're lucky to be alive."

They say 'Poor dear' so sweetly that you forget to tell them the one good thing about it, which is that it keeps you warm. I never had a cold till I got here and cleaned it off. And look what a 'beaut' I've got now. I tell you, Missus, the mud's never hurt me. Neither has the war. Why, I used to have asthma somethin' fierce; but now it's all 'partee.' If we get home with all our arms and legs and eyes—or just enough to get on with—this here war's goin' to be a good thing for a lot of us.

"Of course, I ain't sayin' it's pleasant; far from it. There's the route marches and the everlastin' salutin' and the bully beef and the bumps on the ground at night. But there's compensations. Take my case. I had *three* sisters all learning the piano at once, and all of 'em dubs

at it. Yeah, it could be worse. Pass the cake, Kid."

Two more Australians, whom I know only as Phil and Steve, are ready for tea. As I pour, I ask the big one, "What's that you're wearing in your hat?"

To which he replies unsmilingly, "Kangaroo feathers, of course."

And when I want to know what his friend carries that enormous knife for in his belt, he unhesitatingly answers, "Appendicitis."

"Say, this is a boshter (fine) place, eh Phil?" says the red-haired one.

Phil nods in hearty assent, though his mouth is truly too full for utterance. After a little while, however, he slows up, and begins to tell me about some of the fun they've been having. The best evening was the one on which they began by beating up a taxi driver because he refused to take them five miles into the country.

"By thunder, lady, that bloomin' blighter was a funny sight, wasn't he, Steve?"

THE AUSTRALIANS' DINNER PARTY

Steve says, "Righto, especially when his nose bled the most."

The aunt of another pal, having discovered their presence in Paris, invited them to dinner. They left their hotel "perfectly good citizens, at peace with all the world." After they'd finished with the chauffeur they got into his car, pulled down their sleeves, leaned back, and "lighted up." Arrived close to their destination they stopped the taxi, got out, overwhelmed the frightened and bloody driver by the size of the tip, and then proceeded the rest of the way on foot, 'cause they "had the wind up" at the thought of eating with a lady.

"You tell the rest, Pete," says Phil shyly.

But Pete insists that he "hasn't brought his music," so Phil continues:

"You see, we really wanted to meet Sam's aunty, and we really wanted to eat that dinner, but the nearer we got to her house the scairder we got. We went past three times, and once Pete had his foot on the lowest step; but we got seasick again and hurried away. Fourth time, just as I said, 'Let's smoke one more before going in,' the door opened and a little, round lady, with nice twinkly eyes, came out and said: 'This is the house, boys. Come right in. Dinner's almost ready.'

"So we did, and first thing you know, Pete here was having a fine time, like he always does. We both spied a big photograph of Sydney harbor on the wall, and that gave Pete something else to talk about. As for me, well, I just couldn't think of a word to say, and I got to worrying about what the lady must be thinking of me. Poor soul! She married a 'Froggie,' but at that she *seems* happy.

"When the time came to go in to dinner, a lady servant with awful nice feet looked in at the door and said: *'Madum, eh survy.'* She looked right at *me,* too, and though I didn't savvy, I winked back. But nothing happened. Aunty just said, 'Mercy' (Merci), and we all 'fell in.'

"Mr. Froggie was very nice and very polite—very. Always saying 'Pardong' and making funny little bows. But I liked him at that; for of course he can't help his ways, now, can he? He told us that Madum was deelighted to have us in 'cause she'd never gotten over being Australian. Everything to eat was going to be Australian, not a single sauce on nothin'.

"When we got into the mess-room, first thing I noticed was a treemennjus bowl of Australian wattle blossoms."

"You're crazy," bursts in Pete. "It was French mimosa."

"MY NAME'S THE GUSHER, BUT TONIGHT I CAN'T SAY A WORD"

"Oh it was, was it?" shouts Phil. "You call it by any new-fangled French name you want to. It'll always be plain old golden wattle to me. As I said before, there was a huge bunch of *wattle* blossoms on the table. I gave one look and sniffled right out loud. I just couldn't stand it a bit longer; so I said: 'Mrs. Australia'—I called her that for, in the first place, I could never pronounce her Froggie name, and in the second place, I think 'Mrs. Australia's' *mighty* pretty, so I said, 'Mrs. Australia—most of us have got a nickname in the army. Mine's the 'Gusher,' 'cause I talk so much. But tonight I can't talk at all. I'm thinking of

Photograph by William Brandt

THE STRASSBURG MONUMENT

Today, the Strassburg monument is more than a memorial to Alsace, more than an expression of the proud spirit of France. No longer draped in mourning, but bright with the tri-color, it is a declaration that might does not make right.

home and I can't say a word—not a word.'

"Well, she just leaned over, patted me on the shoulder, and said: 'Then, why try?' She's dinkum (the real thing), she is—dinkum as they make 'em."

A Scotty takes a vacant chair and I go to the kitchen for fresh tea. As I pour it I see that it is unusually strong, and offer to bring hot water. But no; he wants it strong, very. I say: "My goodness, I should think you'd be too nervous to fight."

And most seriously he answers, "Beeleeve me, sister, *I am.*"

A solemn-looking boy, who hasn't said a word during all his tea, gets up, thanks me, and goes away. At which two of the others burst into hearty laughter as they inform me that "the poor boob is upset because he can't forget the face of the Fritzie he 'finished.'"

"LET'S NOT TALK SHOP"

Everybody at the table concludes that "he'd better wait until he's got something to worry about." But, upon questioning, most of them admit that sometimes the things one sees are not exactly pretty.

"For example," says one, "that time the 'big one' came just when sixty of us were coming out after 'fourteen days of it.'"

At which an elderly man speaks up:

"The saddest sight ever I saw was this morning, in Notre Dame. A nun came in with forty-eight children all in black. She told me that every one had been orphaned by the war.

"But, let's not talk shop. Let's talk about the funny things one sees. Once I was driving in a long line of transport lorries. Suddenly, it seemed almost before I heard the shell, I saw an overcoat sailing through the air. The sleeves were waving wildly and I laughed till I cried. I ran up to it and saw there was something inside; but I kept right on laughing. When I got back to my car I met a mate, who said: 'Say, I got a fine pair o' legs here. You know who owns what goes with 'em?'"

A disheveled boy, sinking exhaustedly into a chair, exclaims:

"Geeminy crickets, I'm tired. Paree or no Paree, I'm going to bed right after tea. My back aches and I'm full of bruises."

"Too bad," I say, "just in from line, I suppose."

"Line nothing," he sneers. "I've been learning to roller-skate."

As I fill his cup for the second time, a nice "homey" sort of a lad wants to know "where all the pretty workers come from." He goes on:

CHOCOLATES ALL GONE—TIME FOR THE WAR TO END

"Now that little one in black, with all the yellow hair, will *do* me. She told me yesterday that after the twentieth of the month you won't be able to find a *single* chocolate in all Paris. *Think* of *that,* fellows! Just about time for this nasty war to end, don't you think? This place is certainly top hole, and I wrote in the visitors' book how I felt about it. What did I write? Just 'Better than a married life.'"

"Proving, of course, that you are not married," I say.

"Proving, of course, that *I am,*" says he.

After a minute I'm asked if I've seen Mack today.

"He promised to meet me at the corner of the Roo Day Rivullay and the Roo Fourth Day September, and I waited till my feet got sore. I say—here he is now. If you don't mind *too* much, Mack, I'd like to know"—

"Yes," fumes Mack, "all I had to do was to *find* that corner. After I'd hunted for it most of the afternoon I asked a Frenchy. He began with the first verse, which he did solo. When he got to the second quite a crowd had collected. So I said: 'I'm a peaceable man myself. Have it your way.' And here I am."

"Mack" seems a good sort and tells me he likes music. From the wide, soft, many-plaited band around his hat I know that he likes "swank," too. Also he likes books and asks me if I've read the story of Gallipoli, just published by an Australian. He goes on to relate that his mother has sent him a copy, but that it's "no bone" (*pas bon*), for the author contends that every Australian is a hero.

During the shouts of derision which follow this statement I defiantly announce that every Australian *is* a hero. At which five modest youngsters rise, make me a gallant bow, and exclaim as with one voice, "We nevah contradict a lady."

"I KNOW IRISH EYES WHEN I SEE THEM"

After they have gone there is sufficient time to permit me to clear my table and prepare it for the next "reinforcements." I slip over to another part of the room, where three "workers" are intently listening to a fourth, who is narrating something thrilling, beginning: "And *he* said"— But I shall never know what he said, for a glance over my shoulder shows me that again every seat at my table is occupied. So I hurry back.

"Why, you're all Canadians this time, aren't you? That's nice," I say, as I busy myself about my pleasant task.

"Easy, easy, lady," says a mischievous-looking baby. "I'll venture to say you smiled just like that at your last tableful,

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Y. M. C. A. BARRACKS FOR AMERICAN FIGHTERS IN PARIS

Here is a home for the soldier "just in," where he can realize the dreams of months at the front and enjoy freedom from discipline, hot baths, and *sleep in the morning!* "Freshly shaven, uniforms brushed and pressed, boots of a dazzling brilliance, happy faces, happy laughter, happy hearts"—by these signs ye shall know those who are "just in."

and that there wasn't a Canuck amongst them. You see, I know Irish eyes when I see them."

I don't answer because my attention is fixed on a rough-looking individual who is making a violent arraignment against America and all things American. He is saying:

AN ATTACK ON FOOLISH AMERICAN BOYS

"They make me sick with their talk about their umpteen million men and their steen billion airplanes. And they send a handful of toy soldiers to France, and these guys sit in cafés and tell about how, since we couldn't finish the war ourselves, they've come over to do it for us, and that if they can't *win* Belgium back they'll *buy* it back, and that if their fathers' incomes could be added together it 'ud make something like"—

Here I can stand no more. "But surely you don't hold a whole nation responsible for the talk of a few foolish boys?" I demand as calmly as possible.

Furious at being interrupted, he wants to know why it's my funeral to "stick up for the rotten Yanks."

And when I reply, "Because I happen to be one myself," he only whispers, "Well, I'll be double damned."

As he goes out, however, he stops for a second to hiss into the ear of the first speaker, "*You* and your Irish eyes!"

An alert, middle-aged man is on my right, seated between two clear-eyed, upstanding boys. He introduces me, oh how proudly, to what he terms his "offsprings." All three are in the same regiment, and Eddie is twenty-one—celebrated his birthday day before yesterday, right here in Paris. What do you know

Photograph from W. W. Rock

THE PALACE OF THE TROCADERO, SEEN THROUGH THE ARCHES OF EIFFEL TOWER

The art treasures of Paris are clustered like jewels in a setting, and one need only turn from masterpiece to masterpiece. On the dome of the Palace of the Trocadero, seen in the distance, is poised Mercié's "Fame." In the beautiful park, which slopes down to the Seine and the Bridge of Jena, are several fine statues in marble and bronze, and one wing of the palace is occupied by a remarkable collection of sculpture, chronologically arranged for comparative study, with representative casts from the twelfth century forward.

about that? Freddie is nineteen and trying to raise a moustache. And isn't it *wonderful* to have leave together?

Freddie tells me it wouldn't have been possible except that father said he didn't mind; he'd postpone *his* leave till the kids got theirs. Which makes Eddie join in with:

"But you can always count on father. When you need him, he's *there*. Why, when Freddie got plugged in the leg"—

But father says, "Don't bother about that now, son."

And when I tell father what a splendid thing it is to see three such fine soldiers from one family, he only smiles, but he seems pleased. He explains that "his partner at home has a weak heart, but manages to keep the business going, so there was no reason why *he* shouldn't have come. And as for the boys, well, *look* at 'em!"

A BIRTHDAY DINNER, "JUST LIKE A BOOK"

Father himself, so he insists, is hard as nails and can stand the grind better than "either of these brats here." Then all three begin a recital of the interesting things they've done, and when I tell them of several places they haven't visited yet, Freddie marks them down in a little red book.

Then Eddie, with great enthusiasm, starts the story of the birthday dinner. How, not knowing one word of French, they couldn't make the waiter understand that they wanted oysters. When they'd pretty nearly given it up as a bad job, Freddie ran out into the street, returning with an oyster shell taken from a

Photograph by G. Frederick Atherton

A VIEW OF THE SEINE

The river has wound its silver thread through the stately, dramatic, and violent years of Parisian history, but never through a chapter more poignant or exalted than the present, when France has become for all civilization the symbol of heroic sacrifice.

great stack on the sidewalk. *Wasn't* he clever?

And father ordered *two* kinds of fish, though, of course, he hadn't meant to. And the only way they got nuts for dessert was by imitating a nut-cracker with their hands. Even the waiter laughed, and the proprietor gave each of them a post-card, with a picture of the restaurant on it, to remember him by. Wasn't it *just* like a book?

And every night, no matter how tired, they wrote a joint letter to mother.

"MOTHER'S THE BEST SPORT IN THE FAMILY"

Freddie told her what they'd done from breakfast to lunch, Eddie how they'd filled in the time from lunch to dinner, and father how they'd passed the evening. So mother wouldn't think she was forgotten for a minute. I guess not. Why, every morning since they'd left her, soon as their eyes popped open, first thing they all did was to pull out her "pic," salute, and say, "Good morning, little mother."

And guess where they carried her? In their caps, of course. Easy to get at, you know.

"Gee! if she could only be along tonight! Going to *grand opera!* And the seats cost *something* — fifteen francs apiece, if you please. But, shucks, mother wouldn't mind. Why, mother's the best sport in the family." I agree to that.

As I pass the bread to a newcomer I recognize an acquaintance of yesterday. In answer to the usual question, "How long have *you* got?" he had informed me with a knowing wink and a dig in the ribs that he might be here a "considerable" time; for he is private chauffeur to the colonel and "the colonel's got his lady." He slips me a little bunch of violets under the table because I "was so good to him yesterday," but he'd like to know why I took so much trouble to direct him to the "booleyvard"? He grins as he asks:

"Why didn't you just tell me to walk till I smelled the perfume? I found it all right and it cost me a pretty penny, too. Say, I'll bet a guy could spend a thousand francs a day in this town and lead a righteous life. And if he lived the other kind"—

Grand chorus, "Ladies present."

A jolly, fat little soldier bounces into the room, throws his cap on the floor, and beams all around, as he fairly explodes: "*Oh,* what a beautiful Thursday!"

THE STORY OF A BATH

In answer to my unspoken question he explains that every day in the trenches is "like Sunday on the farm," whereas *here*—why, one actually remembers the day of the week. He knows that this is Thursday, for he got in on Saturday night, and getting in on Saturday was the luckiest thing that ever happened to *him,* because that's one of the two days when there's hot water in Paris.

"So," he says, "I turned it on and I stuck my head in the steam, and I filled the tub so full that when I dived into it I splashed all over the place. I hopped out and wiped it up as best I could—anyway, I had *another* towel. Then I slid back with a happy sigh into that bea-u-ti-ful boiling bath, and I soaked—just soaked.

"Some one knocked at the door, and it was the maid; but I said, 'Not at home. Won't *be* at home for quite some time.'

"You see, I can 'parler' a little; so I 'got her' when she said she'd come to prepare my bath.

"I said, 'What? I guess I don't need no lady to prepare no bath for me.' She seemed kinda surprised, and I heard her mumbling to herself, and I wondered what she was doing in my room so long.

"By and by, though, after 'bout an hour, I had a dandy rub-down with a towel that smelled *clean,* for I don't mind telling you that I'm in a real, regular hotel, with elevators and everything. Then I went into the other room and I seen what Maddymoizelle had been up to. I laughed out loud, 'cause she'd drawn the curtains tight—against Zeps, you know. She'd turned down the covers of the bed, all *pink,* and she'd lighted a little lamp, which was pink too.

"I says to myself: 'Curley, this is *y-o-u,* which spells *you.*' And I never was so happy since I got my first pay envelope. I wiggled into that bed slow and careful, so's not to disturb things too much, and of course I hadn't nothin' on. Catch *me* missin' the feel of them sheets. And I've got *five* more nights."

WHEN HE LICKED THE SPOON

I hand the jam to a fellow who wants to know if I've ever seen the Bairnsfather cartoon where poor Tommy, opening another tin of apple jelly, is saying longingly, "*When'll it be strawberry?*"

I nod, but tell him not to be afraid of this brand, because it was made by one of the ladies. So he decides to "take a chance." I notice that his "chance" is a liberal one. As he scrapes the bowl he volunteers the information that his mother always used to let him lick the spoon. At which everybody present yells, "Kamarad," including me.

I go to the kitchen for a fresh supply, and when I get back there is a great discussion about last night's air raid. A thin, nervous, jumpy little man is saying that he reached his room at 8 o'clock, straight from "Hell Fire Corner," and, dead weary, had fallen into bed; but the strange feeling of a mattress under him and four walls around him had chased away all thought of sleep; so he turned and twisted from 9 o'clock until the first bomb fell, at 11.25.

"Then," he concludes, "it was just like 'Home, Sweet Home' in my pill-box, and I woke up this morning at 8."

The two latest arrivals are old friends of mine. I've known them for a week and two days. Today, I'm not so glad to see them, for it's their night to "deepartee," and I hate to say goodby; but they are not *too* sad, as they put it, and the blue-eyed one immediately begins a description of an afternoon spent in the "Looksumburg," and finishes up with, "Gawd knows I've seen enough of art."

ONLY TWO SPEEDS TO FRENCH TRAINS: SLOW AND FULL STOP

The brown-eyed one declares, "It'll be good to get back to the 'mokes' (horses)—anyway. The worst thing about the whole business is the railroad ride back, because in France there are only two speeds for a train, to wit: slow and full stop."

We chatter on about many things until the time comes for me to wish them the

THE PLACE VENDÔME, PARIS

The column was erected to the "Glory of the Grand Army by Napoleon the Great." Bronze from 1,200 cannon taken from the enemy in the campaign of 1805 was used in the spiral band, which depicts scenes of that campaign. Pulled down by the Communards, the column was recast from the old molds and re-erected in 1875.

usual "Good luck!" The blue-eyed one begs me not to worry about him, for "Fritzie hasn't made the shell marked with *his* number"; and the brown-eyed one tells me not to worry about *him,* for he's going to try to live up to the rules. I know he means the rules of the Y. M. C. A., which are: "Live clean; be clean; fight clean; play the game."

We shake hands in true soldier fashion, and I wince as the ring on my finger presses into the flesh.

The blue-eyed one lights a "Players" and goes out whistling, "I know that she'll be waiting, as she promised she would do."

But the brown-eyed one seems to be thinking aloud, as I hear him say, "We who are about to die, salute you."

When I attempt to fill the cups of three new ones, I am stopped by an imperious gesture and a sharp command to bring "three whiskies, quick."

"Oh!" I say, trying not to laugh, "we only serve tea here, you know." And to a most indignant, "Talk about your *rotten* places," they stagger out.

A SUBMARINE SURVIVOR'S FIRST SPEECH

A white-faced, delicate boy in civilian clothes, with a handkerchief around his neck in place of a collar, his ill-fitting coat much too small, and his painfully new shoes squeaking as he walks to the center of the room, begins to speak:

"Hi in't never mide no speech before. Hi in't," he commences in truest Cockney accent. "But hi hintend to mike one now, hi do. Hi and me mites was submarined the other dy. It's the fyshion to be submarined nowadays; so you see we hare very fashionable. Ha, ha! We swimmed a good piece, we did. We got picked up off the coast o' Barcelona, where we wuz took in by kind people. The consul give us these nice clothes to wear. 'E was a good cove, 'e wuz. 'E give us our train fare tom'ere; and I want to say that I never was treated better nowhere than I been treated right 'ere in this 'ere place, and I want to give three cheers for the ladies in Blighty, and—and—well—Gawd sive the King!"

I know it is getting late, for the "reg-

ulars" are beginning to come in. One drags a leg, another trembles constantly, a third has a hacking cough—gassed, you know; but, "once you're in this game, you just naturally got to stay for the finish." Consequently, though for these three the war is over, they are still in uniform.

The first drives a motor transport, which meets the 'on leave' men at the trains, the second's a batman, and the third is in the army post-office. As their wages are not exactly high, the teas in Blighty help out considerably.

The coughing one comes to my table and immediately begins a monologue. He gives us all the news of the day, interlarded with much home-made poetry. He goes on at such a rate that I have to assure the others that he is perfectly harmless, "it isn't shell-shock at all."

"TEA IS SO WEAK IT'S LIKE KISSING SISTER"

According to him, the tea is so weak today that to drink it is like kissing your sister. And he wishes to know if we've seen the startling news in all the papers, that Charlie Chaplin is in first line. This announcement falls like a 5.9 and creates a wild storm of abusive contradiction. Above the din I am able to make out:

"I guess that *that* would be a little *too* much. If the Allies want to end this war quick, just let 'em put Charlie's feet in danger. Why, Fritzie could make his own terms and no one 'ud give a tinkers." That's what it means to be a hero of the screen.

The room is nearly empty now and almost quiet. I've about decided to leave when a gaunt, cadaverous person slouches in. Apologetically he asks if he is too late for tea. Because he looks so wretched, I reply in the negative, just as he notices the signs, "No tea served after 6.45." He smiles gratefully at me, with a smile that changes all his face. We are silent for a few minutes, partly because I'm a little tired, I guess, and partly because I feel a bit timid before this most unusual type of visitor. Suddenly, without a word of warning, he informs me:

"You're right. I *am* a rough customer. *I'm* just out of clink" (jail).

I say, "Ha, ha! Caught with a camera, eh?"

"Worse than that," says he.

So I guess again: "You took all the temper out of your tin hat when you cooked eggs in it."

But he finds no humor in that ancient joke. When I state positively, "You're not the sort for an S. I. W.," he murmurs sadly:

"No; it takes nerve to go in for a 'self-inflicted wound.'"

His face is pinched and drawn, though almost triumphant, as he finally admits his offense: "I hit an officer."

In spite of myself I gasp a little, for this is serious business; but I say nothing, for he has started a very flood of talk.

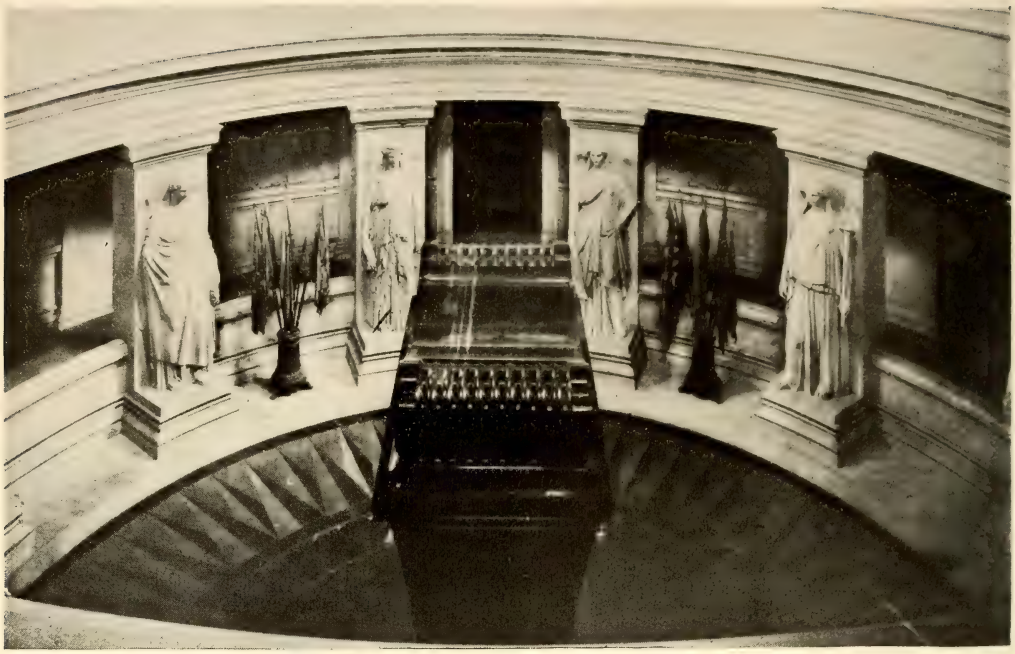
THE FIRST VOLUNTEER FOR HIS TOWN

"I was the first volunteer from my town," he tells me, "because then I thought the war was right. My three brothers came, too. One is blind and two are dead. The littlest one was the prettiest boy I ever saw—absolutely the prettiest. I found him right after they 'got' him, and he looked as though he'd just come from a party. His face hadn't been hit at all, and not a hair was out of place. I helped to bury him; then I sent the cable home. I'm forty years old, and all my life I've had men under me. My father owned a big horse ranch, where I learned how to treat men. And when that young, impudent whipper-snapper dared"—

"Yes, yes," I break in. "I know, but"—

"*You* know," laughs he. "*You* know *nothing*. You get up in the morning, in a steam-heated room, and you look out of the window. If it happens to be drizzling, you say to yourself, 'My, my, today I'll get my little boot soles wet.' When you've had to leave a mate to die in the mud, standing up, because you have only sufficient strength to pull your own legs out, then you know something about war and its glories. Oh, but it's cruel, that mud of the Somme! And that night, when I'd worked in it, slept in it, and swallowed a lot of it in my rations for ten days, that insufferable cad, that unmentionally odious tuppenny ha'penny captain"—

"Can't you forget it for a little while now? Your tea will be stone cold. Be-



THE TOMB OF NAPOLEON

No soldier on leave from the trenches ever visits Paris without at some time visiting this matchless monument, reared by the French in memory of the foremost captain in the history of military science.

sides, one of these days we're all going home," I say desperately.

"Maybe so," he sighs. "But somehow, after more than three years, we sort of stop counting on it. You see I sailed from Sydney on what should have been my wedding day. I'd been engaged a long, long time, but wouldn't marry, for I'd bought a bit of land and wanted to be out of debt first. For exactly a year I lived alone in a hut. I was my own cook, and I tell you frankly I was low and dirty; but each month I knew I was getting a little closer to the end, because each month I was able to buy another cow or two. And there wasn't a happier cuss in the land.

"NEVER FEAR FOR ME: GOD HELPING ME, I'LL CARRY ON"

"Then—well, the war came. So I leased the place to a dirty slacker, and the next week the government gave him a contract for his whole output of milk and he's getting rich. As for me, all I ever asked of life was peace and quiet. Would you like to know how I've spent most of my leave in Paris? On a bench in a park watching the kiddies at play. If I could just wake up in my room, with the comfortable old furniture and with all my things in a drawer!

"If anything at all were to be gained by my being killed, don't you think I'd submit to it gladly? But what's the good of it? All my old friends are gone, and new ones come and are mowed down, and the war goes on, and each day some big brain evolves a cleverer and more ghastly way to do the slaughtering"—

"The little Padre is singing again," I softly venture. "Listen:

> "'When I get home at eventide,
> God will remember and provide.'"

My poor tired fighter gulps a little over the last mouthful, rises, and, looking down at me from his great height, says very simply, "Never fear for me, madam; God helping me, I'll carry on."

And as I remove the last of the dishes and the half-faded flowers; as I scrape up the crumbs and fold the cloth, I keep thinking, "That's right. God helping us, we'll all carry on."

THE NATIONAL GEOGRAPHIC MAGAZINE

THE GEM OF THE OCEAN: OUR AMERICAN NAVY*

BY JOSEPHUS DANIELS, SECRETARY OF THE NAVY

IN POPULAR acceptance the navy is a fighting organization. Unless it is ready to fight and win victories, it fails of the main purpose of its existence. Its chief aim and object is national defense. In time of peace it studies and learns, and in time of war it practices the art of naval warfare.

In the naval service men are in training for a generation to fight, perhaps, for only a single day. But such a day! as when John Paul Jones said, "I have not yet begun to fight," as he boarded the enemy ship and sailed away with his prize; or when Lawrence won immortal fame by his admonition to his associates, "Don't give up the ship"; or when Perry, in his hour of triumph, sent the message, "We have met the enemy and they are ours"; or when Macdonough won the decisive victory on Lake Champlain; or when the *Monitor* and the *Merrimac* ushered in a revolution in naval construction and warfare as they clashed in mortal combat at Hampton Roads; or when Farragut steamed into Mobile Bay, heeding not the torpedoes; or when Dewey's guns at Manila conquered Spanish sea power and Dewey's diplomacy prevented German aggression; or when a few weeks ago the destroyer *Fanning,* assisted by the *Nicholson,* captured the whole crew and sank a German U-boat. Naval battles are always short, sharp, decisive.

It is because the tactics and the strategy call for quickness and the battle is won or lost in a few minutes that there is a glamour and a fascination and a glory in encounters at sea that appeal to the imagination more strongly than the larger and more sanguinary conflicts on land.

EVERY GENERATION HAS HAD ITS WAR

There has been, on an average, one war in every 29 years of our national life, and in most wars the naval engagements can be counted by minutes. Men, therefore, spend most of their careers getting ready for the supreme moment. It may never come, but woe to that officer who lacks initiative and coolness and courage in the one moment when all he has learned and practiced is worthless unless he can summon it to his command upon the instant of decision!

Great generals have won renown who were masters of the defensive, and there are times when Fabian methods on land spell victory. But at sea, the captain who depends upon defense is lost. Offensive methods, daring attack, ability to maneuver so as to obtain the advantage, and to shoot quickly and hit the enemy vessel—these are the essentials of high command afloat. They are attained only because the navy, in its shore establishments and afloat, is maintained and oper-

* Address by Hon. Josephus Daniels before the National Geographic Society, Washington, D. C., Friday, March 29, 1918.

Photograph from U. S. Navy Department

PHYSICAL TRAINING: SHELF DRILL AT A NAVAL STATION

"In the naval service men are in training for a generation to fight perhaps for only a single day." The training is mental and physical, for a battle is won or lost in a few minutes, and each man must fit perfectly into his place in the fighting machine (see page 313).

ated for the sole purpose of increasing the fighting efficiency of the fleet.

In times such as these, we naturally think only of the fighting side of the navy. But just as we need, in the construction of a battleship, to apply the work of more trades than are used in any other single structure built by man, so the navy, in its organization, utilizes a very large number of the arts and sciences, and produces as by-products, so to speak, of its main work many results which are of general interest and application in the maritime, engineering, industrial, or purely scientific fields. Thus the navy maintains a large number of building and repair yards in addition to a big gun factory which makes a majority of its guns.

In other words, the navy, as one of the largest employers of labor in the United States, has to deal not only with the problems incident to this, but with problems of civil and mechanical engineering, such as must be handled in the industrial world.

THE NAVY STUDIES INTERNATIONAL LAW

Even the Naval War College, founded primarily for the "study of problems of modern warfare in a manner at once scientific and practical," is one of the few institutions of the United States where the science and problems of international law are carefully studied. Officers of the navy are among our leading experts on international law, and, indeed, they need to be, for it falls to them more than to

Photograph from U. S. Navy Department

ON THE FORWARD DECK OF A DESTROYER

The word "periscope" from the lookout brings instant action, and every man leaps to his appointed place. Accuracy and eternal wakefulness are making the Atlantic sea lanes safer and safer from the submarine peril.

any other class in the country to apply the rules and principles of this science, which is rather neglected at present, when autocratic nations regard a solemn treaty as a mere scrap of paper.

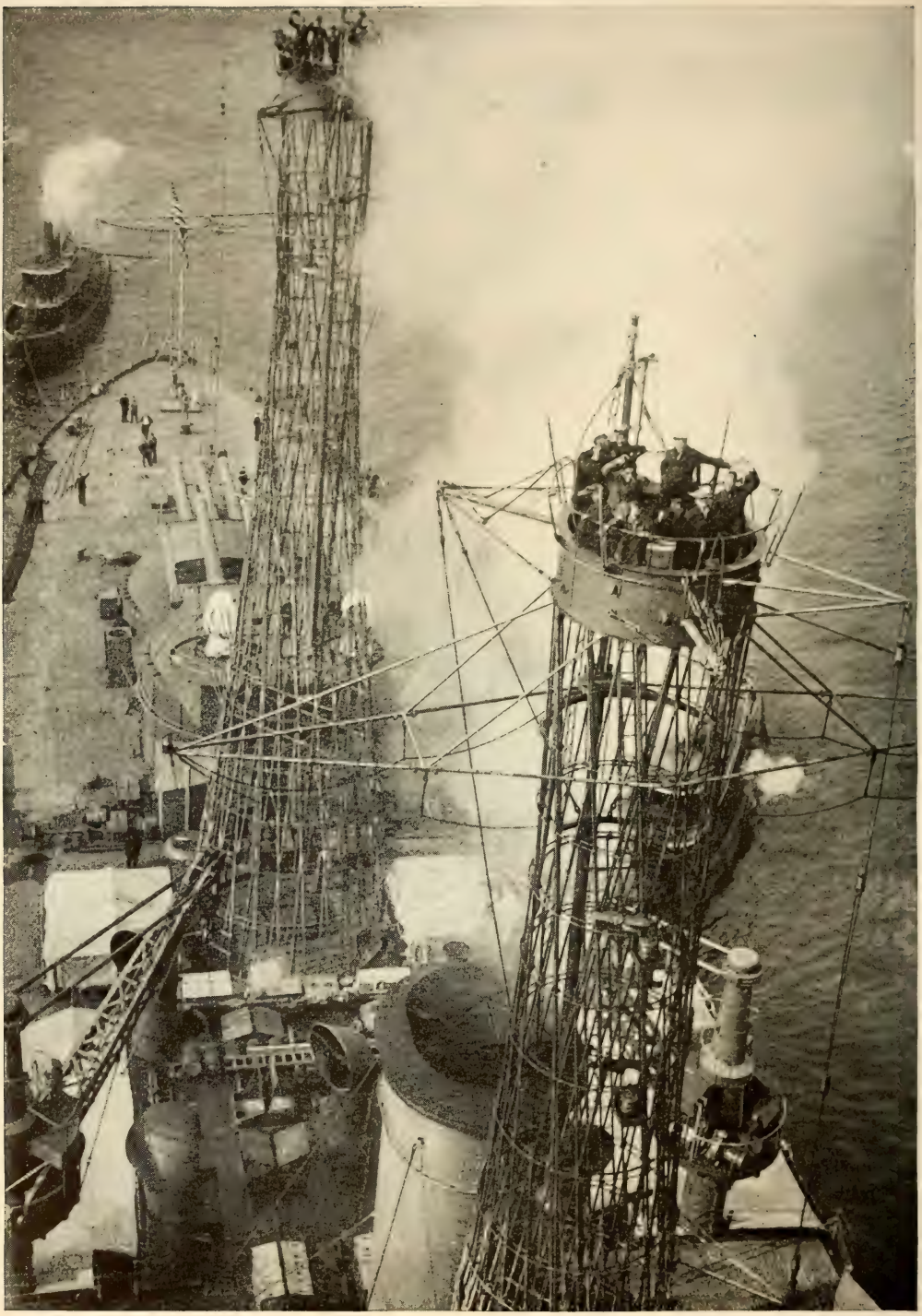
Navigation—a special branch of astronomical science—is needed for every ship that crosses the ocean, merchant as well as naval. For accurate navigation, there are required correct tables of the positions of the heavenly bodies at any time, instruments for observing the sun, moon, and stars, chronometers for determining correct time, and compasses for determining directions.

All work having to do with navigation is centered, for the navy, at the Naval Observatory in Washington, which compiles and publishes the *Nautical Almanac,* universally used; checks and corrects chronometers; studies compass problems and naval instruments generally. All of this work is freely given to the public and utilized by mariners generally.

The Hydrographic Office, another branch of the Navy Department, established more than fifty years ago by act of Congress, has for its purpose, in the words of the act, "the improvement of the means for navigating safely the vessels of the navy and mercantile marine by providing . . . accurate and cheap nautical charts, sailing directions, navigators, and manuals of instruction . . . for the benefit of navigators generally."

THE WORK OF THE MEDICAL CORPS

The principles of medical science apply to men in the navy as well as others, and the large and efficient Medical Corps of the navy has always contributed its share to the advancement of medical science generally. In times of stress, such as these, when the Medical Corps is much more than doubled, it draws in medical



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PUTTING THE FINISHING TOUCHES UPON A DREADNAUGHT

In the construction of a battleship there is applied the work of more trades than are represented in any other single structure built by man

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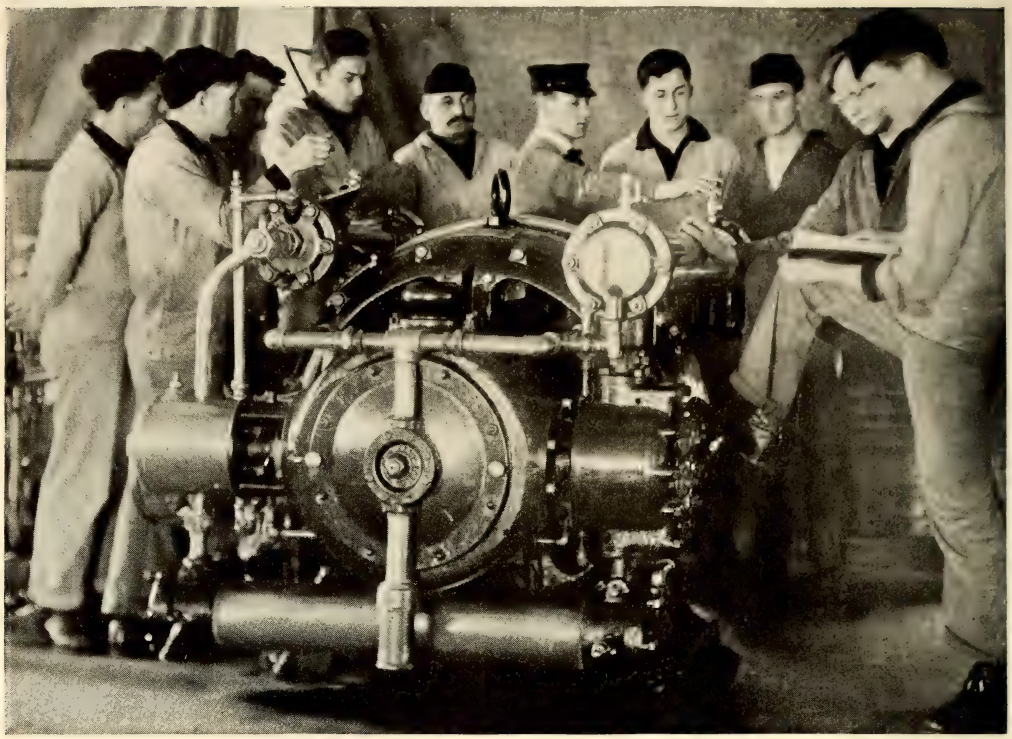
FORWARD DECK OF THE "MISSISSIPPI"

The men on a battleship spend years of intense practice getting ready for the single hour of a great sea fight. From early dawn until long after the shadows have deepened into darkness, every man among them is on the job. Now gun drill, now "abandon-ship" practice, now collision drill. Efficiency, more efficiency, and still more efficiency is the unceasing demand of the navy. And if you will watch how every man is at his post and doing his allotted task with the assurance, the precision, and the ease that come only from untiring practice, you will understand why those who know the American Navy from the inside have supreme confidence in its ability.



Photograph from U. S. Navy Department

A CLASS IN ENGINEERING AFLOAT

The navy as a training school in peace times is a great institution. It brings discipline to the untrained and world views to the untraveled. It drives home the lesson of good citizenship, creates respect for constituted authority, and fosters the improvement of head, hand, and heart. A little world within itself, often for weeks with only sea and sky around and above, the personnel of a modern battleship's crew develops an *esprit de corps* seldom equalled on land.

men from civil life, with the result that in time of war the relations between the naval doctor and the civilian doctor are even closer than in time of peace. Many of the special problems which the naval doctor has to deal with are found in civil life, and his knowledge and results are available for their solution.

For instance, not in the most crowded portions of our most congested cities will there be found so many souls living, breathing, and having their being in a given space as on a large naval vessel, with its crew of more than one thousand. Yet on battleships the health and comfort of the crews are at a maximum.

In the mechanical field, as already indicated, the navy handles many problems whose solutions are of value in civil life. At the Experimental Model Basin, for instance, at the Washington Navy Yard, though devoted primarily to improving the shapes and lines of naval vessels, a large number of tests have been made for private shipbuilding companies, who have made free use of this plant in the preparation of designs for merchant vessels.

There is a Navy Experiment Station at Annapolis, with a mechanical and engineering laboratory, and just before the war began Congress authorized a large research laboratory which, though primarily for navy use, will, of course, give much information on engineering subjects generally.

BY-PRODUCTS OF NAVAL ACTIVITIES

As this partial summary indicates, the navy as a by-product, so to speak, of its regular work makes progress in the arts and sciences which is of use (and made

use of) in civil life. Moreover, in ordinary times there has been a constant outflow of officers from the navy who engage in civilian pursuits, in many cases with distinguished success. For example, a very large proportion of the shipbuilding industry of this country is now under the direction of former officers of the navy.

There is, however, another side to this: The navy has always prided itself upon the fact that it made free use of the civil developments of the arts and sciences that are of value for its purposes. Something over two years ago the Department undertook to systematize and further develop this principle by organizing the Naval Consulting Board, in recognition of the fundamental importance of scientific work and scientific specialists to the navy organization as a whole. The Board is now made up of the most eminent scientists and inventors of this country, with Mr. Edison as its chairman, and two representatives of each of eleven leading American technical societies. These societies all chose men eminent in their respective professions, with the result that the Board as a whole is composed of men of great individual prestige, and in this war has devoted itself to the study of naval problems.

WHEN THE NAVY SPEAKS FOR ITSELF

The navy as a fighting agency, as the embodiment of power, as the protector of the country from aggression, is today the pride and the reliance of America. But that navy can speak for itself, is speaking for itself through its more than 350,000 men and more than 1,000 ships now in active service, and will speak with greater emphasis when the hour comes for which all other hours have been but preparation.

Never did a nation have more right to be proud of its navy than America has now, and never were fighting ships manned by men of such skill and valor as our fleet is today. Let us send to them across the ocean, in their vigils and in their perils, a message of cheer, a message of confidence, and a message of pride.

Once in 29 years the navy is called upon to fight. If in all the 26 years of peace, for a war usually lasts three years, its officers and men concerned themselves only with getting and keeping ready, the feeling of safety such a navy affords would be worth all that it costs.

Today we have all come to agree with Gouverneur Morris, who, when referring to the navy and the expense therefor, said in the Senate: "When we have 20 ships of the line at sea we shall be respected by all Europe. The expense compared with the benefit is moderate—nay, trifling. Whatever sums are necessary to secure national independence must be paid. If we will not pay to be defended we must pay for being conquered." Those words never sounded so true as today. They have in them the ring of prophecy and warning.

In the intervals between wars the navy has not found its only occupation in practice and drill and maneuvers, in simulated warfare, making ready against the day when it would be helpless unless it is always ready.

THE NAVY AS AN INSTITUTION IN PEACE TIMES

In many ways it has demonstrated its necessity as a peace institution, and in its contribution to the spread of knowledge, to the extension of commerce by opening new doors to hitherto unknown peoples, to the discovery of new worlds, to the charting of the seas, to pioneer work in securing victories through diplomacy, to the study of the stars, to decreasing the time of ocean voyages and cheapening traffic by sea—in these and other ways the American Navy has been a leader, and all the world is debtor to it, because, aside from its place as a fighting machine, it has been a pathfinder in days of peace.

Palmerston was not thinking only, or even primarily, of naval warfare when he said of English officers what is equally true of American commanders afloat: "When I want a thing well done in a distant part of the world," said that typical John Bull statesman, who incarnated all the prejudices as well as all the virtues of his countrymen, "when I want a man with a good head and a good heart, lots of pluck, and plenty of common sense, I always send for a captain in the navy."

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U. S. S. "NEW HAMPSHIRE" FIRING A BROADSIDE

At every broadside of one of our newer dreadnaughts more than eight tons of metal, driven by more than two tons of smokeless powder, are discharged. Such velocity have the great shells that they would pierce five feet of wrought iron. The salary of the Admiral of the Navy for a year is only a little larger than the cost of one such broadside. One of our new ships has more fighting power than Dewey's whole fleet at Manila.

Photograph by Kadel & Herbert

BATTLESHIP "PENNSYLVANIA" AT SUNSET

Commodore Perry, "the Father of the Steam Navy," could hardly have imagined such a development as this enormous fighting ship represents. Peacefully rolling at anchor as the sun goes down, it becomes a silent watchdog of the night, but can burst into action with a flash and belch forth stupendous destruction upon an enemy threatening our shores.

Photograph from Ernest T. Fauroat

U. S. S. "GEORGIA" IN A TYPHOON: PACIFIC OCEAN, NEAR JAPAN

All naval vessels operating in the war zone are equipped with boat or life-raft capacity sufficient for every person on board. A stock of life-preservers of an improved type has been manufactured sufficient to supply one to each officer and man on board all vessels.

He might wisely have omitted the words "in a distant part of the world."

THE NAVY'S WORK IN SCIENCE AND EXPLORATION

The Navy in Peace—Its Work in Science and Exploration—let that be our thought at this session of the National Geographic Society, while the whole world reels in the throes of carnage on this day holy for all Christians. For though, through the smoke and gas and darkening of the heavens by death-dealing bombs, we may not see even its dawning, our faith looks beyond the roar of battle to the quiet days of peace that will once again smile upon a world made better—let us trust and believe—by the sacrifice which men who love liberty have been forced to make lest "might should rule alone."

I doubt not that we shall live to see the day when peace will once more beckon us and we can take up again and upon a larger scale the mighty works of discovery and exploration which in other peaceful days have been so large a part of the daily task of our American Navy.

But peace will not find us as we were before the war-lords plunged the world into blood. We shall never again be an isolated nation, living unto ourselves, concerned only with our own affairs, leaving to the comparatively few men of science and love of adventure and to the statesmen the keen interest in all things that concern the human race. Nor will we come back to ancient formulas, to old shibboleths, to the adoration of the Golden Calf we had set up, or even to the gods of Pleasure and Tradition and Gain we worshipped. We have learned in these testing days that these gods of ours had feet of clay.

With wide-open eyes, with larger vision and better appreciation of our re-

© Commander James B. Gilmer

PLUNGING INTO THE DEEP: U. S. S. "NEW YORK" IN A HURRICANE

Fighting forces on land are frequently deterred from offensive operations by storms, but at sea it often happens that the fouler the weather the greater the possibility of a brush with the enemy.

sponsibilities to our fellows, and with a spirit of glorious adventure and achievement, America will in the days to come sail every sea, chart every river, see its flag flying above its commerce-laden ships in the harbors of the uttermost parts of the earth, for "no pent-up Utica will contract our powers."

THE UNIVERSE WILL BE OURS FOR HELPING OUR FELLOW-MEN

By service we shall claim "the boundless universe" as ours, not by conquest, but by opening new avenues for helping our fellow-men. Knowing that

> "There are firths beyond Pentland
> And friths beyond Forth,"

we shall explore them all and leave no resource undeveloped and no clime unknown.

And when, with a world-wide horizon, our America is once again happy, youthful with the zest of discovery, who will be our heroes? We will not find them in the staid statesmen of other days, who thought that the Alleghanies constituted the farthest outpost of possibilities, and that beyond the Mississippi was a country not worthy of exploration; who hugged the chimney corners of the Atlantic seaboard; scoffed at Jefferson for the vision that caused him to send Lewis and Clark to that new land "where flows the Oregon"; or saw nothing to make their pulses thrill in the voyages of discovery which were made by Wilkes and Perry, and Lynch and Lee, and Page and Ringgold, and Rodgers and Hall, and Herndon and Selfridge, and Todd and Hodges, and Schley and Sigsbee, and Peary, and scientific research along original lines by Maury and Pillsbury and other like explorers, and naval diplomats like Perry, who in this day would be well called "forward-looking men."

The new world, which, with a new heaven and a new earth, and new ideals,

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A "MOVIE" SHOW ON A BATTLESHIP

The motion-picture screen is a medium of education in the science of warfare as well as a means of entertaining the youths who man our warships

and new justice, and new equality, and new brotherhood of men—which will be born out of the war, I say—this new world will have no place in it for men who look backward. Reactionaries in politics and in geography will be relegated to museums, and the leaders of the new America will make Charles Wilkes and Matthew Calbraith Perry and Matthew Fontaine Maury their exemplars, as they go forth looking for new worlds to conquer, and to conquer as Wilkes and Perry and Maury made their conquests.

NAMES THAT WILL INSPIRE THE FUTURE NAVY

These names, which will stimulate emprise and daring, are on the roll of honor of the American Navy. There are other names of equal honor in their professions, but in explorations on the sea the navy, naturally and properly, blazed the way, and their careers and their deeds will be the inspiration of the younger men, who will leave no nook or cranny of the world unexplored, no body of water uncharted and no river unnavigated.

Photograph by Burnell Poole

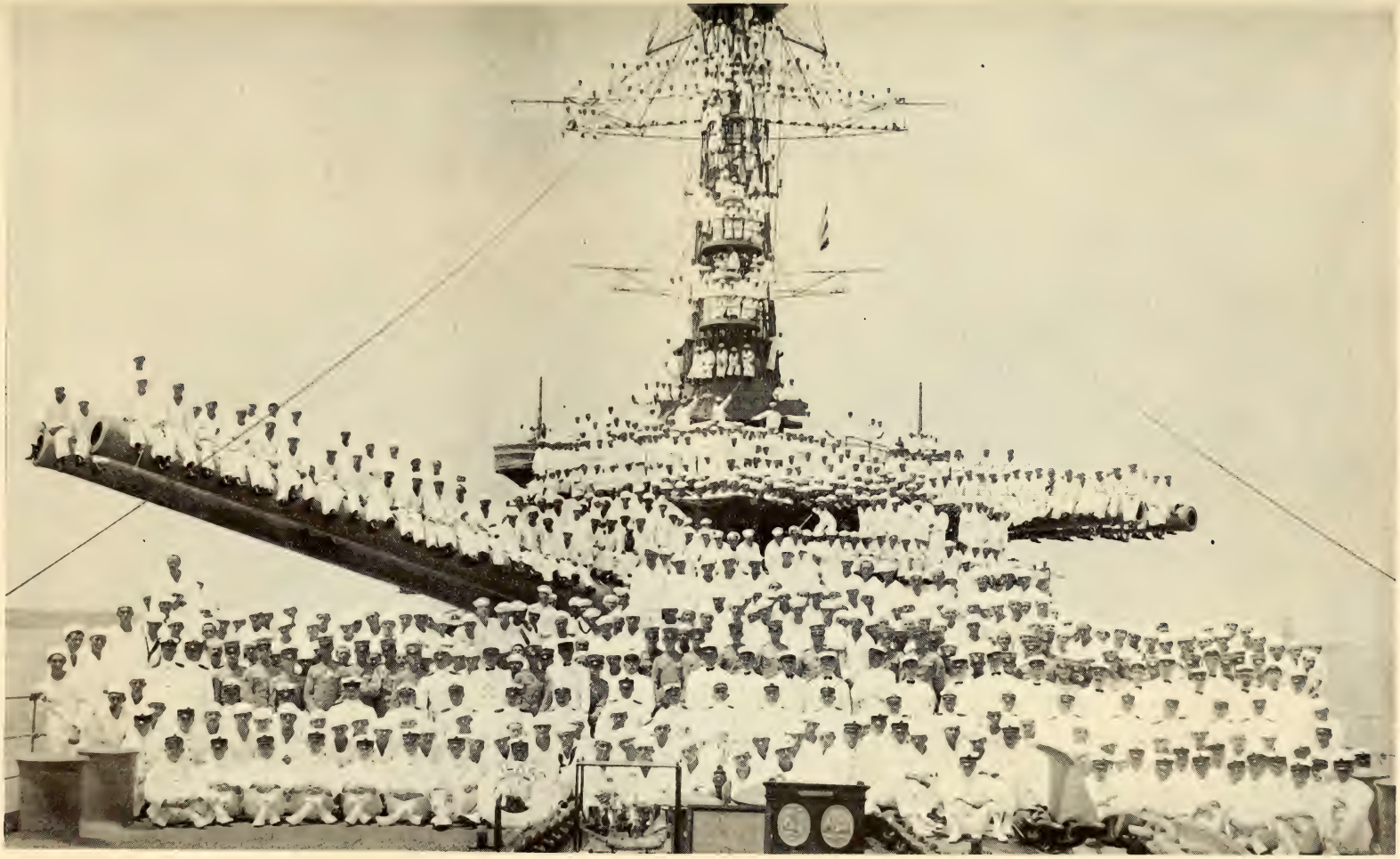
U. S. S. "ARIZONA" AT SEA

The business end of this great American battleship, coming head on, is a formidable sight; broad of beam, bristling with guns, and manned by a thousand of the bravest of the brave, and every mother's son of them trained for his work.

These naval pioneers of the past—whether charting the waters of China and securing the treaty with Japan, like Perry; discovering the Antarctic Continent and contributing more to the world's knowledge of geography than any other man, like Wilkes; or making navigation a science, forecasting the weather, mastering the mysteries of the winds and currents, uncovering the knowledge of ocean meteorology, and making the phenomena of the Gulf Stream known to us, like Maury—these are the types of men who will be reincarnated in the adventurous youth of the golden days of discovery that challenge the intrepid and ambitious, and who, when this war is over, will be satisfied with no rest until all the secret places are flooded with the light, and all cheerless homes blessed with the comforts of our newer and better civilization.

GETTING READY TO GO OVER THE TOP

The navy afloat never loses sight of the fact that it may have duties ashore; therefore the men are as well trained for participation in landing operations as in sea fighting



© O. W. Waterman

THE OFFICIAL FAMILY OF THE U. S. S. "TEXAS"

For the first time in our history a United States fighting vessel has been named to commemorate the heroism of an enlisted man. Through the prompt action of Chief Gunner's Mate Osmun K. Ingram and the *Cassin's* officers and crew, that destroyer was brought safely to port after having been torpedoed by a German submarine. Engaged on patrol duty, the *Cassin* located the undersea boat and gave chase. The submarine fled, but discharged a torpedo at its pursuer. Seeing that the deadly missile would strike his vessel amidships, the *Cassin's* commander rang for extra speed. Ingram, realizing that the torpedo would strike in the vicinity of a quantity of high explosives on deck, which if set off would destroy the vessel, jumped to the spot, threw the dangerous freight overboard, but was killed at his self-appointed task. Secretary Daniels has recently named a new destroyer the *Ingram* as a tribute to this deed.

A NEW ORDER OF WARRIORS WILL FARE FORTH

When the war ends, and a stable peace, based upon government only by "the consent of the governed," has everywhere been established, the men who will sail the seas will neither go on voyages of conquest nor for the exploitation of peoples of other nations. They will be true knights, not going forth with that romantic chivalry which lacked practical knowledge and science.

These knights of our new day will be fired not with less noble purpose, but with more seasoned and practical ideals than those celebrated in song and story. These adventurous spirits will indeed ride abroad to redress wrongs, but they will not carry sword and spear or be hampered with mail and burdened with clanking armor.

They will be, first of all, men of the sea, who, noting the toll of human life exacted by ignorance of winds, and currents, and ocean paths, and harbors, will make safe the navigation of all the waters of the earth. Their weapons will be charts, and compasses, and buoys, and signals, and lighthouses, to the end that men who "go down to the sea in ships" may do so in safety from any hidden rock or treacherous shoal. They will study the life of Maury and his charts. They will consecrate their lives to his spirit of shortening ocean traffic and lessening dangers to navigation by the employment of every agency science and study and experience afloat may make available.

But safe navigation with these modern knights of sea communication will be only the ends to the larger means, for they will utilize these pathways of the seas for the interchange of products and ideas that will make the people of the whole world partners in all that man has made and all that man has learned.

National lines will indeed remain, and love of homeland still grip the hearts of men of varying climes and different tongues. The tower of Babel will not be torn down. We will not return to one Volapük. No knight-errantry will seek to compel men to speak the same language, and thereby lose to the world the folk-lore, the traditions, the literature that mark the growth and illustrate the life of every nation.

LINES OF NATIONAL SUSPICION TO BE OBLITERATED

But lines of national suspicion and distrust of other nations will be obliterated, as these new knights convince all to whom they carry their faith and their wares that no selfish ends tarnish their invisible armor, and that their mission is one of hastening the sway of universal brotherhood based upon universal justice.

These modern knights of enduring peace will be no mere dreamers. They will not expect all of a sudden that the selfishness of human nature will be eradicated by raising the wand and saying, "Be thou gone." They will recognize that justice alone will usher in the new era for which they have put on their armor, and their creed will be that the man who would have equity must do equity, and their religion will be that of the Man of Galilee, who said: "Whosoever will be chief among you, let him be your servant."

So that, as our modern Knight of the New Era of Peace carries his cargoes to the isles of the sea, he will open new doors of trade by a traffic that seeks no unfair advantage, giving from his country in fair exchange what is needed by the country with which he trades.

But he will recognize that, no matter how peaceful is his mission, or how honorable his purpose, or how unsullied his knighthood, the same spirit may not at first be found in those with whom he trades and visits. He will be warned by Mark Twain's story of the bad man, Slade, on the western frontier.

SLADES AMONG THE NATIONS

In a sudden quarrel with Slade, a big teamster drew his gun first and "had the drop" on the bad man. Slade laughed and said: "Ah, throw your gun away and let's fight it out with our fists." The angry giant then threw away his weapon and started for Slade to give him a good beating. Slade drew his gun and shot the big simpleton through the heart.

There are Slades among nations, and when a militant enemy says, "Let us have

Photograph from Burnell Poole

AMERICAN BATTLESHIPS IN COLUMN FORMATION

"The battle fleet, now twice as large as in peace times, has by no means been idle. Ships have been utilized as schools in gunnery and engineering to train the thousands of gunners and engineers required for the hundreds of vessels added to the navy and the many merchantmen furnished with arms and gun crews."

peace; we accept your doctrine—'no annexations, no indemnities'—throw away your guns," a people silly enough to practice the folly finds that Slade has kept his gun and demands not only indemnities, but territory and complete subservience.

We may not expect all nations to accept the just tenders of world-wide brotherhood in the spirit in which they will be tendered by the twentieth century after-the-war chivalry. Therefore, all the peace-loving nations must enter into an international agreement neither to throw away their guns nor to tie up their war ships, but to make them one common international peace police on land and sea, tendering to all nations, great and small, the High Court of Arbitration for the settlement of all differences, ready to enforce the decrees of that tribunal and make this police force so strong that no war-lord will ever again dare resort to the sword to impose his will or his country's greed upon other nations.

KNIGHTS OF GEOGRAPHY

These practical Knights of Peace and Justice will master the secrets of earth and sea and sky for the comfort and improvement of the race. They will let no water power remain unharnessed. They will draw nitrates from the air to enrich the earth. They will utilize present agencies of production, so that plenty will bless mankind and unlock the secrets of nature to increase production faster than population makes demand for food and raiment and comforts—aye, and luxuries, also; for the best is none too good for all who labor.

Discoveries now undreamed of will respond to the master touch of men and genius, and we shall transport, without loss, from one continent to another the products and wares that will add to human happiness. These new knights of

Photograph from Burnell Poole

NAVY AVIATORS WITH HYDRO-AIRPLANE

While not so swift as the smaller, lighter aircraft, designed for service over land, seaplanes have proved of invaluable aid to the allied navies as scouts, and especially in the detection of submerged U-boats.

science and industry the new day will usher in, will prevent any fruits or vegetables going to waste in the tropics that would please the palate of any man in the furthermost North. Waste will be eliminated from Pole to Pole.

Governments, instead of being required to spend billions on arms, will raise large sums for the creation of instrumentalities of education and research and scientific production until no man who labors will lack anything that will give nourishment or add to his happiness. Selfish individualism will be replaced by enlightened coöperation.

DAYS WHEN PROFITEERS WILL BE DEAD

And whatever any nation produces that is good will be made available without profiteering to men and women in every other nation.

Chemists and workers in ordnance and in making munitions will be freed from making agencies of destruction, so they may carry on experiments and operations to multiply all things that will sustain and make life more abundant, instead of increasing the butchery of the race.

Education of all, medical treatment without cost, and free hospitals for the aged and infirm—the real tests of civilization—will be universal. Teachers and physicians and preachers will be honored above captains of wealth and exploiters and politicians.

These will be some of the fruits of the peace that will bless the world when "the Parliament of Man and the Federation of the World" comes to us. And it will come—let no man doubt that. We shall find this "place in the sun" not for our country alone, but its warmth shall surely bless all mankind. Men and women in this gathering will see the prophecy fulfilled in their day, when

> "No one shall work for money and no one shall work for fame,
> But each for the joy of the working,"

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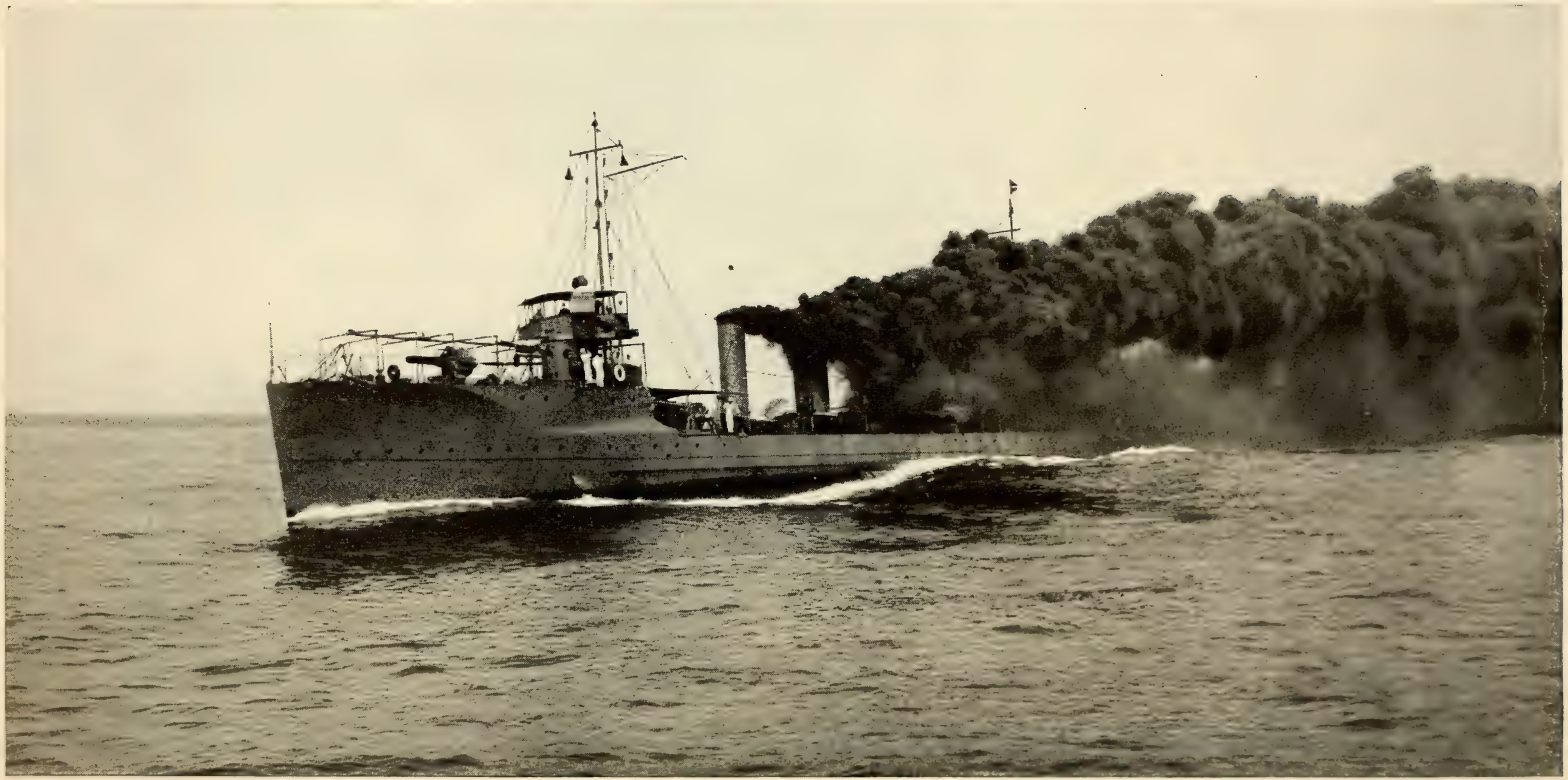
"BUSTER," THE BOSTON BULL, MASCOT OF THE NEW "TEXAS"

A ship's crew without its mascots is like meat without salt. Dogs, goats, bear cubs, monkeys, young lions, anything. And if there are any possible tricks the tars neglect to teach these community pets, naval annals omit to record them.



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CAMOUFLAGE OF THE SEA: A DESTROYER THROWING OUT A SMOKE SCREEN

Concealed behind the thick smoke of their convoying warships, merchant vessels are crossing and recrossing in safety the zone wherein the Hun submarine lurks on the lookout for its prey

Photograph from M. Rosenfeld

AN AMERICAN SUBMARINE SUBMERGING

In conjunction with the undersea flotillas of Great Britain, America's submarines are waging ceaseless warfare on the German U-boats On several occasions it has been demonstrated that sometimes "it takes a submarine to catch a submarine."

Photograph by Edwin Levick

THE NAVY IN PEACE

What could be more illustrative of the quiet majesty of peace-loving America than this picture of a land-locked harbor with the nation's outposts of the sea lying peacefully at anchor? But the war is on and the supreme hour cannot be far away. Soon it will come, and America need not shrink from its test.

and for the benediction which unselfish labor for others will give to this old world, which will be born again.

But how will this miracle be accomplished? Men living in the new day we visualize will not reach this high plane by some new revelation or by being transformed into angels. They will find their inspiration and their stimulus in what their fellow-mortals before them have done. The miracle will be performed when the whole people study the lives of the three most eminent naval explorers—Wilkes, Perry, and Maury—and translate the actions of this triumvirate of heroes into world-wide practice.

UNIVERSAL HISTORY THE HISTORY OF THE WORLD'S GREAT MEN

"Universal history," says Carlyle, "the history of what man has accomplished in this world, is at bottom the history of the great men who have worked here. They were the leaders of men, these great ones; the modelers, patterns, and in a wide sense creators, of whatsoever the general mass of men continued to do or attain; all things that we see standing accomplished in the world are properly the outer material result, the practical realization and embodiment, of thoughts that dwelt in the great men sent into the world; the soul of the whole world's history, it may justly be considered, were the history of these."

With full understanding of the truth expressed by the Sage of Craigenputtock, I invite a contemplation of the lessons in the lives of Wilkes and Perry and Maury as the beacons that will guide us into the larger and nobler world I dare believe we are to live in and make us worthy of these heroic souls.

"We cannot look, however imperfectly, upon a great man," declares Carlyle, "without gaining something by him. He is the living light-fountain, which it is good and pleasant to be near. The light which enlightens, which has enlightened the darkness of the world; and this not as a kindled lamp only, but rather as a natural luminary shining by the gift of Heaven—a flowing light-fountain, as I say, of native original insight, of manhood and heroic nobleness, in whose radiance all souls feel it is well with them."

GREAT MEN WILL CALL US TO "CARRY ON"

The heroic naval figures, which beckon us as students of geography and lovers of our fellows, were men whose scientific and diplomatic achievements were equaled only by their spirit of adventure, their love of the open sea, their quest for the unknown, and their intrepid daring in seeking new continents and new experiences and new discoveries.

Youth is ever attracted by the careers of those who blazed new paths. No young man is a "standpatter" or a recluse or a stay-at-home. The quest of new worlds is his ideal of a life worth while. It is because of this that the story of Charles Wilkes has all the fascination of romance.

"It affords me much gratification to report that we have discovered a large body of land within the Antarctic Circle, which I have named the Antarctic Continent," was the terse, sailor-like statement with which Wilkes announced the result of an expedition which had cruised completely around the world, discovered a new continent, now called Wilkes Land; determined the position of the South Magnetic Pole, and had charted 500 islands and atolls, together with 100 harbors, accompanying them with sailing directions and observations of tides and currents, and charts which are still used by navigators—the results of a voyage of six years, from 1838 to 1844.

It has been said that no other single American expedition ever contributed so much to the world's knowledge of foreign geography. Wilkes received the gold medal of the Royal Geographical Society and is one of the patron saints of the National Geographic Society.

FEW ACCIDENTS IN THE WORLD OF DISCOVERY

There are few accidents in the world of adventure and discovery. Wilkes was selected to command the exploring expedition by reason of his energy and his scientific attainments. He had served as head of the Chart Depot, in the Navy Department, where he set up the first fixed

Photograph from U. S. Navy Department

A SWIMMING CLASS AT A NAVAL TRAINING STATION

Many a merchant sailor cannot swim, but it is because he has never been in the navy. Here this instruction is a part of the curriculum, and in this generation a bluejacket who cannot swim is a rarity.

Photograph by Edwin Levick

LIBERTY AND HER DEFENDERS

"Never did a nation have more right to be proud of its navy than now, and never were fighting ships manned by men of such skill and valor as our fleet is today" (see page 317)

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A PRECIOUS MOMENT SAVED: LAUNDRY WORK DONE WITHOUT WAITING

Shore leave is universally desired whenever a ship arrives in port, and the launches ply back and forth, from the great gray bulldogs of the sea to the landing places, pulling barges behind them loaded to the gunwales with bluejackets on furlough.

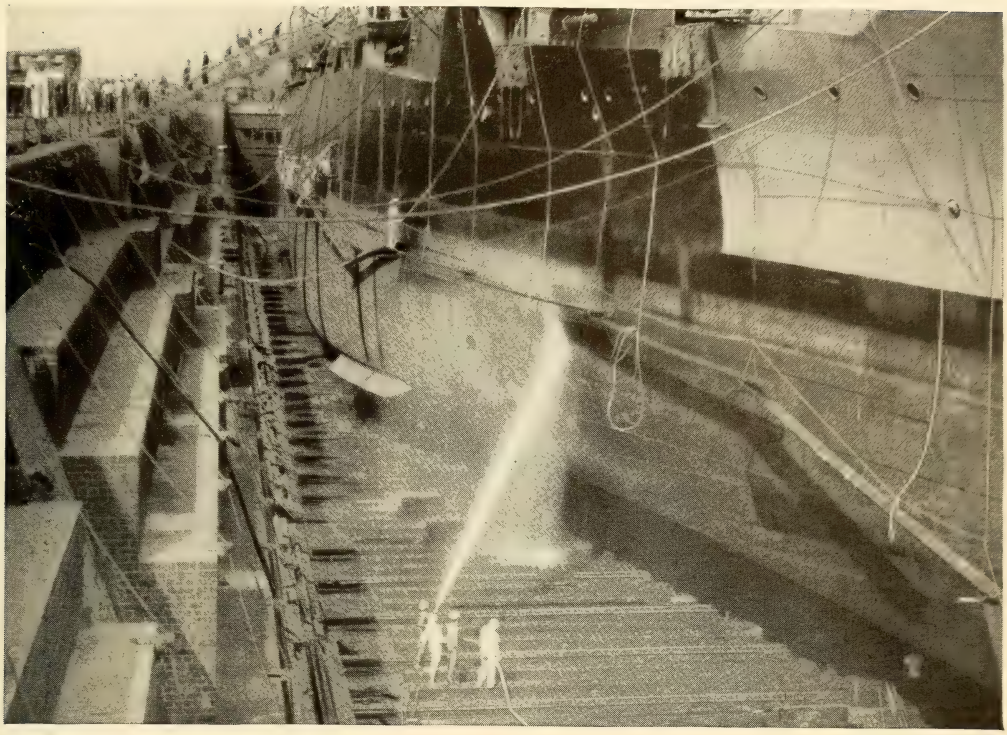
astronomical instruments in the United States.

In addition to his volumes telling of his discovery of the land which now bears his name, he wrote several works, among them "Western America, Including California and Oregon" and a work on "Theory of the Winds." In the war between the States, he commanded the *San Jacinto* when Mason and Slidell, Confederate Commissioners to England, were taken from the English mail steamer *Trent,* for which he received the commendation of his government; and he was later in command of the James River Flotilla and the West India Squadron.

I call him "a living light-fountain," not only because of his discoveries, but because, imbued with the real American spirit, he rendered his service for all mankind and never even suggested that the lands discovered should be appropriated by his government or that the value of his explorations should be monopolized by the United States. The expedition was undertaken for scientific and industrial reasons. Its results became the property of the whole world. He neither sought for himself nor for his country, which paid the cost of the expedition, anything that was not open to the fisherman and voyager of other nations. It is because of this spirit that I commend Charles Wilkes as a naval hero, the study of whose life will help in the realization of the golden age which lies before us.

COMMODORE PERRY A BRILLIANT DIPLOMAT

The early services of Matthew Calbraith Perry foreshadowed his illustrious career. He was entrusted with the delicate mission to Japan because he had shown constructive statesmanship as a naval officer. He was privileged to choose the location for the first free black settlement in Liberia. He is called "The



© Burnell Poole

GETTING READY FOR A NEW DRESS

After a ship has been dry-docked and the bottom freed of barnacles it is washed down thoroughly with fire-hose. Then the painters take charge, and in a little while she comes out as spick and span, with her war paint on, as though she had just come from the ways.

Father of the Steam Navy." He revived the use of the ram in naval warfare. He founded the naval apprentice system. He was active in suppressing the slave trade on the Guinea Coast. He adjusted the Canadian fisheries dispute in 1852.

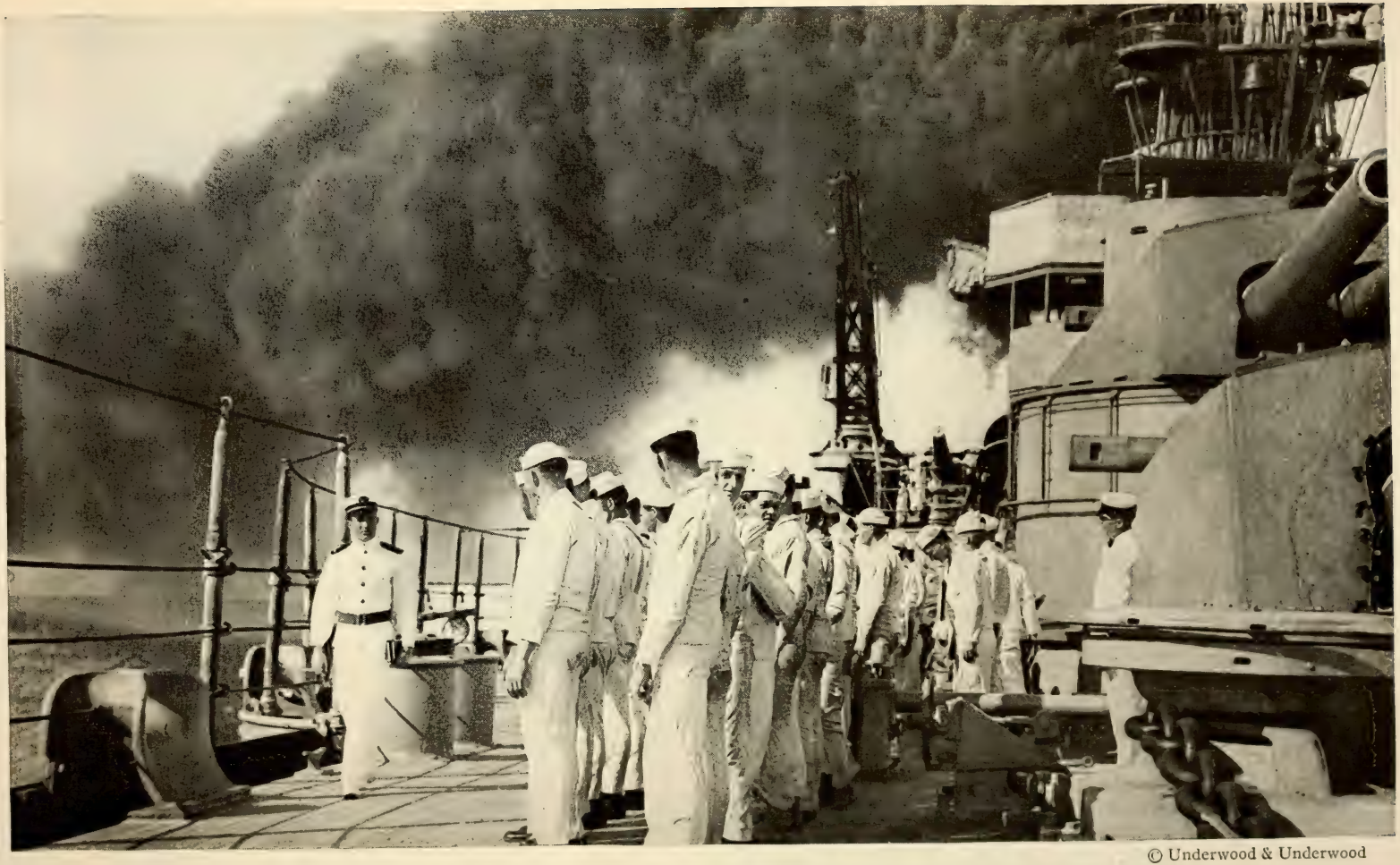
He helped greatly in removing duelling, grogging, and flogging from the navy. In 1847 he commanded the largest squadron which up to that time had ever been assembled under the Stars and Stripes. It was the first American fleet governed without the lash, flogging having been abolished by Secretary Graham. It was that fleet which decided the day at Vera Cruz and started General Scott on his victorious way to the City of Mexico.

The triumph of Perry upon which his fame chiefly rests was the opening of Japan to the world, one of the most important events in our history. The story of Perry's voyage to Japan has all the glamour of the stories of the Orient, and is fascinating beyond the imagination of the most fertile novelist. Armed with a letter from the President of the United States to his Imperial Majesty the Emperor of Japan, saluted as a "Great and Good Friend," Commodore Perry made a thorough study of Japan and the Japanese character before starting on his epoch-making voyage.

TAKING WESTERN INVENTIONS TO JAPAN

He carried as presents specimens of the products of the farm and factory, which he thought by their novelty and usefulness would interest the people of Japan. A miniature locomotive, with tracks and rails to be laid down, one mile of telegraph line with Morse instruments, photo-cameras, printing-presses, puzzles and toys, some of the newest things in America, were in the cargo.

The story of his wisdom, his patience, his consummate diplomacy, going into weeks and months and years, the employment of every art that statesmanship



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AN AMERICAN BATTLESHIP USING A SMOKE SCREEN IN THE WAR ZONE

In previous wars a battleship's smoke has always been considered a necessary evil, betraying the vessel's approach to the enemy; nowadays the tell-tale smoke is employed as a veil to conceal secret maneuvers

Photograph from U. S. Navy Department

A CREW IN A SHIP'S READING-ROOM

There is no sight in the American Navy that is more gratifying than to go through the quarters of the men and watch them studying. For many years they had been taking correspondence courses with remarkable success, but when Secretary Daniels came into office he broadened this work and has made it possible for an enlisted man to win an appointment to the Naval Academy, thus once more opening the honored road that leads from the forecastle to the quarterdeck.

Photograph by U. S. Navy Department

ON THE TARGET RANGE, NAVAL TRAINING STATION, NEWPORT, RHODE ISLAND

"Put your trust in God, my boys, and keep your powder dry," was Cromwell's famous admonition. The American officer adds, "and learn to aim straight;" for, with the modern high-power rifle, having an effective range of two and four-fifths miles, the sharpshooter is a foe of enormous potentiality.

and strategy could invent, is as thrilling today as when it was first told. He had gone to Japan with a friendly key to open the door for the furtherance of trade, the protection of life, and to obtain a treaty with a power destined to occupy a large place in the world. Hurrying nothing, observing every ceremony that would appeal to those he would win as friends, Perry's success marked him as a diplomat of the first water.

When the negotiations had reached a stage where the high contracting parties had about agreed, Hayashi wished to insert a clause that no American woman should be brought to Japan. Tradition has it that when this proposition was submitted the Commodore excitedly exclaimed, "Great Heavens! If I were to permit any such stipulation as that in the treaty, when I got home the women would pull all the hair out of my head." And that was half a century and more before those wonderful evangelists, Anna Howard Shaw and Carrie Chapman Catt, taught us to believe in woman suffrage as a new creed in geographical and political expansion!

Overlooking the harbor of Nippon stands a monument to Commodore Perry, commemorating the sailor-diplomat whose wisdom made Japan and America know and esteem each other. The friendship between these two nations has been

Photograph from Burnell Poole

CLEANING SHIP IN DRY-DOCK

"Skyhooting through the brine" develops a "foul bottom" after a while, and the ship must be floated into a dry-dock and scraped free of its barnacles. These creatures of the ocean attach themselves to the ships' sides, and even the roar of the big guns in a broadside or the lashing waters of "twenty knots and better" cannot break their hold.

cemented in the present-day partnership in the war for the triumph of free nations, in which they are allies. The spirit of Perry and Hayashi still pervades both countries, which, in the language of the letter borne by Perry, "live in friendship and commercial intercourse with each other."

Does not the achievement of Perry class him with the great men "as a natural luminary shining by the gift of heaven, in whose radiance all souls feel it is well with them?"

A PEACE BORN OF KINDNESS

It is to the glory of America that, though Perry had a powerful fleet and could have enforced the treaty by the persuasion of big guns, there was never even a thought of conquest or of obtaining any advantage over the people of Japan. Our friendship was disinterested, our methods were those of diplomacy, and our policy was far removed from the thoughts of those nations which seek to dominate other people and bring them under their sway.

Do we not see in this diplomatic victory and this friendship a prophecy of like intercourse of all nations with each other when the passions of autocracy, now burning at white heat, have given place to calm reason and justice? Will not the spirit of Perry, who incarnated American ideals, descend upon the great men who come after him, so that none will seek power by the overthrow of any other nation? Let us in this day invoke the spirit of Perry, the fighting sailor, who lives as the master diplomat rather than the man of war.

The third of this trinity of naval heroes, whose deeds summon us to insure a world safe for commerce and safe for all that makes for the good of humanity, is Matthew Fontaine Maury—sailor,

© O. W. Waterman

POSING FOR HER PICTURE

With her crew dressed in summer white and standing at attention, her nose kicking up just the right amount of gleaming spray, her ensign flying outstretched, and the smoke from her funnels of just the proper density, this American battleship is showing herself to the best advantage for the photographer.

Photograph from U. S. Navy Department

MEN ON THE "NORTH DAKOTA" TURNED IN ON BILLETS IN CASEMATES

When gun drills are over, mess gear is put away, darkness overmasters the sea, and taps are sounded, our sailor boy climbs into his hammock and is rocked in this literal cradle of the deep. And does he sleep? Well, Jack is a busy chap all day long, and who knows so well the sweetness of slumber as he who has a rested mind and a tired body?

U. S. S. "FLORIDA": SICK BAY

"Not in the most crowded portions of our most congested cities will there be found so many souls living, breathing, and having their being in a given space as on a large naval vessel, with its crew of more than one thousand. Yet on battleships the health and comfort of the crews are at a maximum."

scholar, scientist, author—who gave all his discoveries and researches and charts to all who sail the sea, thinking never of gain for self or country.

It was a far cry from the rude cabin in the primeval forest of Tennessee, where Maury spent his boyhood, to the gathering of savants in Brussels, where Maury's fame and Maury's greatness made him the central figure and won for him five honors of knighthood, conferred by the rulers of Belgium, Denmark, Russia, France, and Prussia, and so many medals of distinction he hardly had a place to store them. His career is an inspiration not only to the youth of his country, but the whole world, which he made his debtor.

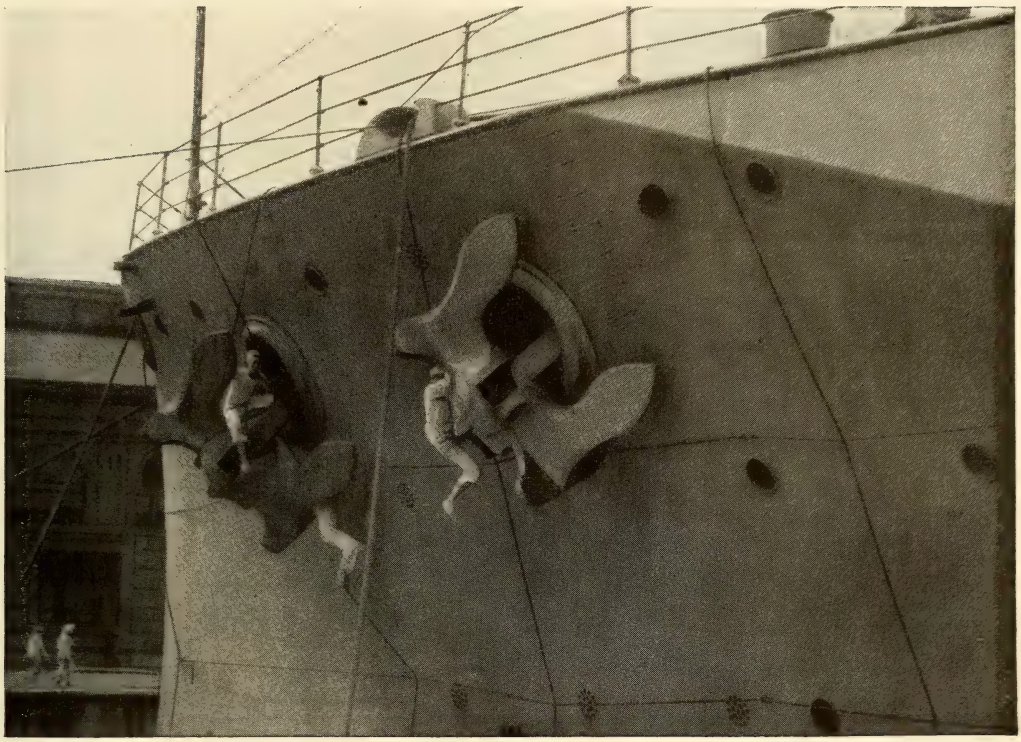
HOW MAURY GREW UP

Maury's father moved from the spacious, open, Virginia plantation when Maury was a small boy. He had the advantage in boyhood of what we call hardships, but which in that day were typical of all homes in the frontier country. Mind and body grew in the open, for hard work on the farm is the best preparation for naval or other rigorous service.

Maury early heard the call to the sea. His elder brother had lost his life in the naval service, and his father opposed Maury's ambition to follow the profession that had robbed him of his first-born, even though the appointment came from Sam Houston, then Congressman from Tennessee. What romantic history hangs around the association of Houston and Maury—fighters both and American pioneers and statesmen, too!

The consuming passion, which made him always follow the path of duty, did not permit even parental objection to dissuade Maury from the high calling in which he was to win primacy.

The Fontaines and the Maurys were among the Huguenots who were exiled



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A SHORT CUT TO THE STAGES

What's the use of climbing a hawser all the way up and over the side when you can climb in by the anchor-chain route?

from France for their religion. They found congenial homes in Virginia, arriving in 1714. Jean de la Fontaine, a man of parts, holding high position in France, became a convert to Huguenot preaching. He was hated because of his holy zeal, and his son tells us he was foully murdered, and piously exclaims in his biography:

"O, my children, let us never forget that the blood of martyrs flows in our veins, and may God, of His infinite mercy, grant that the remembrance of it may enliven our faith, so that we may prove not unworthy scions of so noble a stock." That prayer was answered in Maury's life. His pious father read the Scriptures to his children daily, and Maury's memory was so perfect that all his life he was able to quote from the Bible and give chapter and verse as if the Word were before him.

As a young naval officer, writing to his brother, Maury said: "Learn your duties, Dick, from the Bible. There you have them laid down in example, law, and precept." May we not learn the secret of his greatness in such ancestry and such pious training which burgeoned into such wise counsel!

And may we not in this day of appeals to economy and conservation learn from Maury, who, on an income of $19 a month, supported himself and regularly sent one-half of his navy pay to his sister? And may not lovers find in him a kindred spirit when they recall that, when he became engaged, Maury gave his affianced a little seal to be used in writing to him, bearing for the inscription the simple word "Mizpah" ("The Lord watch between thee and me when we are absent one from the other").

Upon Maury's first long voyage, his ship visited the Island of Nukahiva, one of the Marquesas group, where he narrowly escaped becoming the crown prince. Just before the last war between the United States and England, Maury's brother, John, and six men had been put

Photograph from Burnell Poole

BATTLESHIPS OF THE UNITED STATES NAVY STEAMING ALONG IN COLUMN ON THE BOSOM OF THE ATLANTIC

"The navy as a fighting agency, as the embodiment of power, as the protector of the country from aggression, is today the pride and reliance of America"

Photograph from U. S. Navy Department

GOING TO SCHOOL FOR UNCLE SAM

Under the present policy the boys who volunteer their lives in the defense of their country are valued as units in the great war machine, as well as collectively. Each sailor counts for something. He is a twice-prized citizen, for he is sturdy in his manhood and patriotic in his heart. When he leaves the navy he goes back to private life with the pride of one who counts his country above himself.

ashore on that island to procure sandalwood. English ships blockaded the American ships in Chinese ports, so that no relief came to John Maury for two years. He was befriended by the king of one of the tribes, and when Matthew Maury visited that island 12 years later the king recognized him from his likeness to his brother and offered to adopt him as his son and heir. King of a heathen tribe and "mated with a squalid savage," could Maury have charted the seas?

DILIGENCE BRINGS ITS PROVERBIAL REWARD

There was no Naval Academy when Maury entered the navy. He had been so proficient in mathematics in the country school in Tennessee that he was called upon by his teacher to instruct the younger boys, and on shipboard he continued the methodical study which made him the first scholar and scientist in the navy.

Using a Spanish work on navigation, he acquired a knowledge of the Spanish language along with a mastery of a subject essential to a seafaring man. In his watches he drilled into his mind the formulas from notes made below decks.

Laying broad foundations, it was not until his voyage around Cape Horn, when he sought in vain for reliable information as to the winds and currents to be encountered and the best paths for the vessel to follow, that this need determined the particular study to which he would devote himself. When but 28 years old he published his treatise on Navigation. It attracted favorable attention in this country and abroad and became the text-book of the navy.

Incapacitated for active service by a broken leg, his ambition for command afloat had to be abandoned, though while on crutches he applied for sea service, which was denied him. Writing to a friend at this time, he said: "I'll content myself with cultivating a few little patches of knowledge. What shall they be? Shall they be light and heat, storms or currents? Ship-building or ship-sailing? steam or projectiles? hollow shot or gravitation? gases or fluids? winds or tides?—or—?"

His "patches of knowledge" grew until they almost covered the geography of the world and all naval lore, as the waters cover the sea. In his famous "Scraps from a Lucky Bag," he advocated the adoption of steam as a motive power and predicted a new era in naval warfare of big guns. Did he dream of a gun that could shoot an hundred miles?

A FORWARD-LOOKING GENIUS

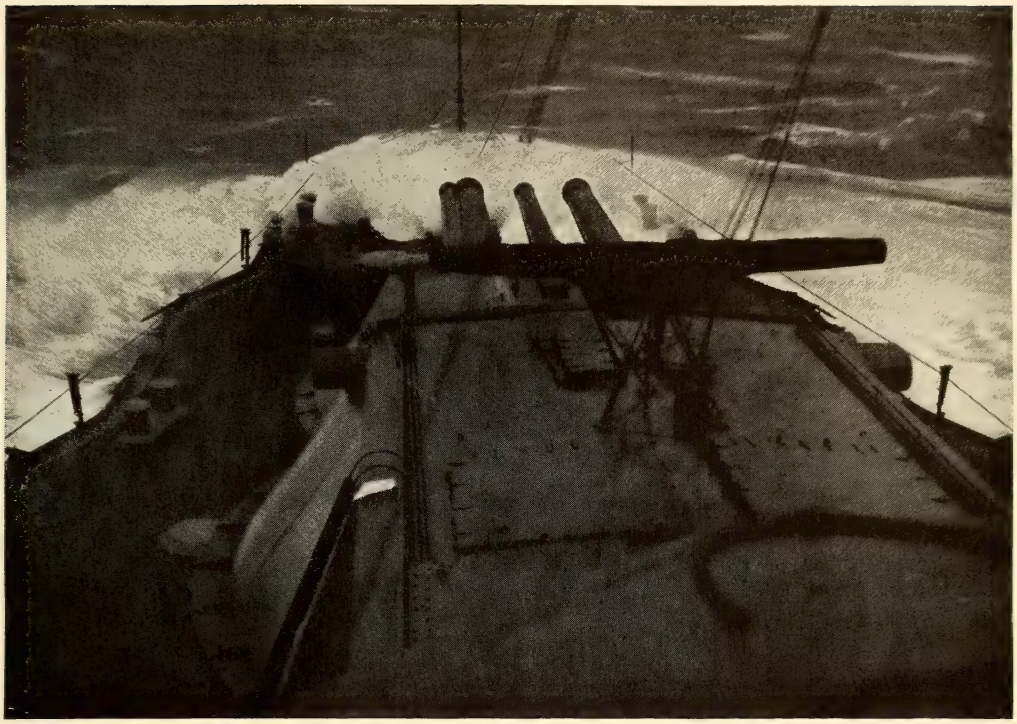
He advocated a naval school for midshipmen, "that they might be instructed in the higher duties of their profession," and urged the use of regular text-books. His new ideas fairly startled old sea dogs, who basked in the glories of tradition and regarded new things as revolutionary. But the reforms that he proposed delighted the thoughtful and ambitious, and stimulated study and exploration and science in the navy.

In 1843, he read to a distinguished audience in Washington, composed of the President and envoys and Congressmen, a paper, "The Gulf Stream and Its Causes," and later a paper on the connection of terrestial magnetism with the circulation of the atmosphere.

In 1844, he was made head of the "Depot of Charts and Instruments," and the *National Intelligencer* truly declared "he transformed the simple Depot of Charts and Instruments into an observatory"—the Naval Observatory—and it has grown until its reputation is world-wide, and other scientific organizations of the government covet its direction.

In late years there has been more than one suggestion that the Naval Observatory, created by Maury and developed by other able naval officers, should be transferred from the navy. In view of such violations of the commandment "thou shalt not covet," it may be well to recall the reason that prompted Maury to accept the post.

Writing to William Blackford in 1847, Maury said: "You know I did not want the place, and only decided to keep it when I heard that it had been promised to a civilian *under the plea that no one in the navy was fit for it.* I then went to Mason and pronounced *that* the repetition of a practical libel and told him he must stand by me. . . . I have solved a problem that has often blistered my



© Commander James B. Gilmer

THE WHITE HORSES OF NEPTUNE: U. S. S. "NEW YORK" BEGINNING TO TAKE SEAS IN AN AUGUST HURRICANE

"Sometimes we see a ship and sometimes we ship a sea," wrote Ben Bos'n. And when a big battleship like the *New York* sticks its nose down into the trough of the sea, you may depend upon it that it is no gentle breeze that agitates the waves.

heart and proved that naval officers are fit for something other than scrubbing decks and tacking ships."

This small depot, literally transformed by his genius, has grown under navy inspiration and under navy direction, and its usefulness in the past, at this critical period, and in the years to come is beyond calculation. No wonder other leaders would like to take over this product of naval vision and naval achievement. By the same token, the navy of the future, with more time for exploration and science, will serve mankind by perpetuating under its own control the valuable service there begun by Matthew Fontaine Maury.

A MANY-SIDED MAN WAS MAURY

Merely to state the varied achievements of this master naval scientist attests his many-sided service. In addition to his purely maritime discoveries and accomplishments, Senator Vest declared "the whole signal-service system of this country originated with the navy, and the man in whose brain it first had existence was M. F. Maury." His system of weather reports has been extended so that on land as well as on sea he was a benefactor, whose ideas have not only made for safety in navigation, but have been of inestimable value to agriculture.

Maury stands easily at the head of naval leaders of peace, and what he accomplished was not for the navy alone, not confined to his country, but became the property of men who follow the sea, as well as men of commerce all over the world. When Maury became head of the Depot of Charts and Instruments, he removed the old log-books, which had been stored away as rubbish in the Hydrographic Office. He extracted the valuable information they contained, collected data from every possible source. He

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ACTIVE SERVICE IN EUROPEAN WATERS: MACHINE-GUN READY FOR BUSINESS

On May 4, 28 days after the declaration of war, American destroyers arrived at a British port to assist in patrolling European waters. The United States Navy was prepared for whatever might come.

furnished new charts and sailing directions to masters of vessels bound for foreign ports, and all captains of ships and others who follow the sea were invited to join Maury in collecting data for making other charts and new sailing directions.

He had the vision and the wisdom to secure coöperation from all parts of the world. Maury writes, in 1848: "The Boston merchants were so pleased with that Wind and Current Chart that they offered to raise $50,000 to buy a vessel and keep her at my orders—to try new routes."

In March, 1849, he wrote: "The charts are going ahead bravely. They are quite as much admired on the other side as on this, and they do turn out exceedingly rich. Some new discovery, some new fact or law of nature, is constantly starting up before us as we proceed with our investigation." It was a period when life was worth living for those who shared Maury's enthusiasm and felt the thrill which new discoveries impart.

A GREAT OCEAN RACE

The papers of 1852 fairly glow with descriptions of the famous, spectacular ocean race between the two first-class ships, the *Governor Morton* and the *Prima Donna,* which attracted as much sporting interest as the deciding base-ball game of our day. These ships sailed together from the port of New York on the fourth day of February, crossed the Equator in the Atlantic Ocean on the same day, though not in the same longitude; entered the Straits of Le Maire the same day and came out the same day; crossed the Equator in the Pacific on the same day and in the same longitude, and arrived at San Francisco within three hours of each other, after a race of 16,000 miles. This was truly a tribute to Maury, and the San Francisco *Times* at that time said: "These two facts demonstrate the accuracy that has been obtained in the science of navigation, and also prove the reliance that can be placed upon the Wind and Current Chart of Lieuten-

ant Maury, whose sailing directions both vessels followed."

What Maury did in saving life by increasing the safety of ocean voyages may not be estimated. Hunt's *Merchants' Magazine* of 1854 calculated that he had shortened the time for voyages to South America and the East Indies by 15 days, and this had effected a saving of $2,250,000 annually in freight charges for the outward voyages alone.

In a report submitted in January, 1855, the Committee on Naval Affairs stated the immediate result of Mr. Maury's labors to be that "ocean voyages under sail are shortened from 10 to 20 per cent. Before the publication of these charts a voyage from our eastern ports to San Francisco, under canvas, occupied on an average 180 days, and in several instances it has been performed in half the time formerly occupied."

The Secretary of the Navy, Hon. James C. Dobbin, wrote that "it is my decided conviction that this officer, by his ability and enthusiasm in the cause in which he has been engaged, has not only added to the honor of his country, but saved millions of dollars for his countrymen."

President Fillmore, in a message to Congress (1851), said that Lieutenant Maury had shortened the passage from Atlantic to Pacific ports about forty days.

WHY MEN SAY REPUBLICS ARE UNGRATEFUL

After an illuminating statement of the value of the labors of Lieutenant Maury, the House Naval Affairs Committee recommended that $25,000 be appropriated, "insignificant indeed in comparison with his services," as the nation's appreciation of the contributions made to the world by this officer. The bill was introduced, and its fate gave fresh evidence to those who believe in the ingratitude of republics. Not only was no money reward voted to him, but in the following month the Naval Retiring Board placed Maury on the retired list, thereby reducing his salary to $1,500!

Maury, like Wilkes and Perry, sought no advantage for himself or his country which other nations might not also enjoy. He secured such coöperation that reports coming from all sources filled more than 400 large manuscript volumes. He had no conception of safeguarding American ships alone. His vision and his services looked to craft that sailed every sea.

He never secured a copyright to any chart, never patented any idea; but all that he learned and all that he discovered his free government gave freely to the whole world. It is because of his unselfish contributions that he is everywhere numbered with the great men who "enlightened the darkness of the world" and live forever with immortals.

He did more than obtain the hearty coöperation which made safe the paths of the sea. He was a "living light-fountain," in that his spirit of faith and devotion caused sailors to see the Creator whom he worshipped.

A SEA DOG'S TRIBUTE TO A COMRADE

Captain Phinny, of the American ship *Gertrude,* gave expression to the new and higher vision that coöperation with Maury brought to him and other sea captains. Writing from Chincha Islands to Maury in January, 1855, Captain Phinny said:

"I am glad to contribute my mite toward furnishing you with material, not only of pointing out the most speedy routes for ships to follow over the ocean, but also teaching us sailors to look about us and recognize the wonderful manifestations of the wisdom and goodness of God by which we are constantly surrounded. For myself I am free to confess that for many years I commanded a ship, and although never insensible of the beauties of nature upon sea and land, I yet feel that until I took up your work I had been traversing the ocean blindfolded; I did not think, I did not know, the amazing combinations of all the works of Him whom you so beautifully term 'The Great First Thought.' You have taught me to look above, around, and beneath me, and to recognize 'God's hand in every element by which I am surrounded.'"

Maury's whole life and service taught that greatest of all lessons not only to sailors, but to all mankind. And that was his greatest contribution, because the man is always greater than his achievements, and faith must ever be the inspiration to noblest endeavor.

FORERUNNERS OF FAMINE

By Frederic C. Walcott

Of the U. S. Food Administration: Author of "Devastated Poland"

SEVERAL years ago Bloch, a well-known Russian banker and economist, said that the next great war would be won not by fighting, but by famine. There is already much evidence to prove the truth of this prediction.

A brief review of the cost of this war in innocent victims shows that famine and starvation, or food shortage, has proved one of Germany's most potent weapons of conquest, and has actually caused as many deaths as has all the fighting in Europe during the last three and one-half years, and far greater suffering.

Moreover, it includes among its victims a large percentage of children and women of the next generation and the mothers of a nation. But, in consequence of the lowered vitality of all the working classes, the decreased resistance to disease, and the decline in the birth rate, the loss suffered in this war by the nations short of food is actually far greater than the loss of those killed in battle.

GERMANY USES FAMINE AS A WEAPON

Furthermore, food shortage has created in those countries conquered by the Central Powers a condition which Germany has used to her great advantage. By the power of famine she has enforced the deportation of the industrial peoples, the backbone of a nation, from their native countries into Germany, thus forcibly breaking down the family unit, causing indescribable terror and mental anguish, which will be reflected in the offspring of these devitalized people for generations.

Russia's shortage of food, due to the breaking down of transportation in the Empire, proved one of the prime factors and one of the inducing causes of the Russian revolution. The bolshevik, which has been the outgrowth of these disturbances, now dominates a majority of the Russian people.

It is representative of their social organizations and of their secret societies. It has taken on a spiritual character, creating in the minds of its followers the spirit of a new crusade, as in the early days of Christianity and of Mohammedanism, and associating spiritual ideas with political ideals, as in the French Revolution.

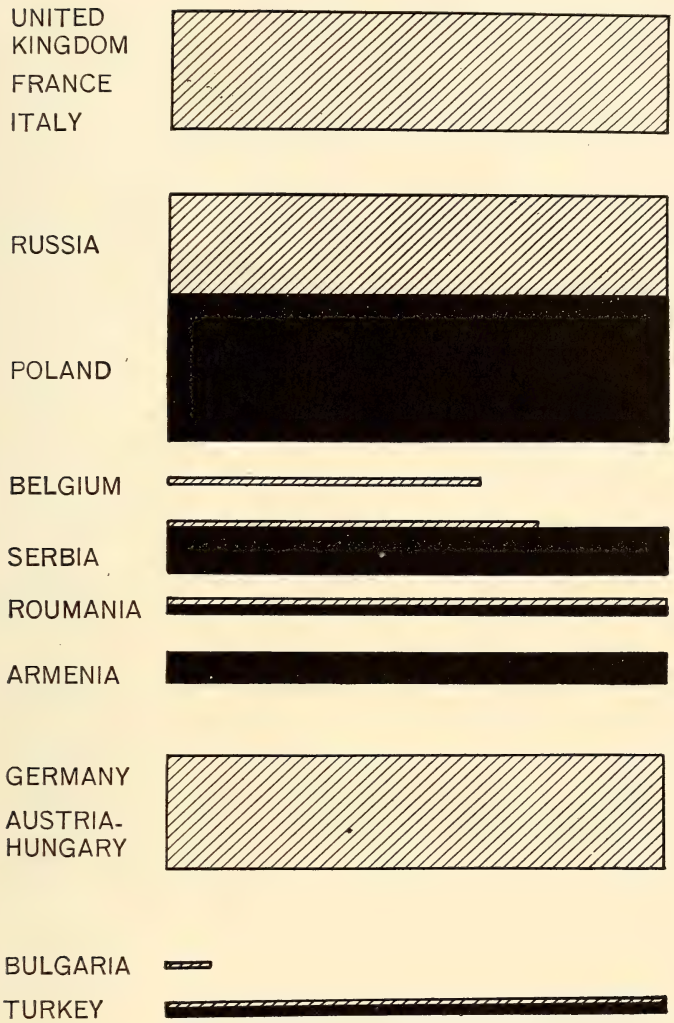
A DANGEROUS AND CONTAGIOUS DOCTRINE

This new and dangerous political doctrine, if it can be called that—in reality it is unbridled anarchy—teaches the people to believe that no government is needed, that law is unnecessary, that the will of the individual is all-sufficient, and that property and land are common to all. In its early stages this "go-as-you-please" bolshevism—Russian for "wanting much"—is popular with the Socialists and working people all over the world.

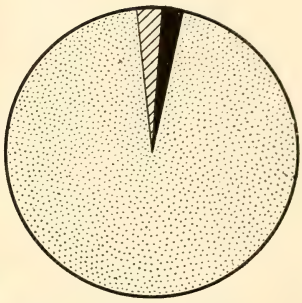
It is very contagious, and now threatens to spread to Germany, England, and possibly the United States. Six months or a year's trial of it will probably bring about in Russia a financial debacle, plunging the people, industrial concerns, and banks of Russia into absolute bankruptcy. In the end, it may prove of benefit through its collapse, thus demonstrating that extreme socialism, of which it is the embodiment, is a disastrous thing. It is clearly our duty to build up a wall against attack from this source—an attack which might lead to our ultimate national downfall.

Russia is apparently out of the war, so far as any effective fighting is concerned, and until she can reorganize her body politic and railroad transportation, she will not be a material factor in the world's food supply; she will be barely self-supporting during her reconstruction period, unless reorganized by Germany.

But if Germany has access to the port of Odessa, and thus, via the Black Sea, to the grain and meat supplies of south-



The lined rectangles represent the deaths by fighting. The black rectangles represent the deaths by famine.



The circle represents the total population of the Central and Allied Powers (the United States excepted), also territory conquered by the Central Powers.

The black area within the circle represents deaths by famine. The lined area, deaths by fighting.

THE TOLL OF HUMAN LIVES EXACTED BY THE SWORD AND BY STARVATION SINCE THE WORLD WAR BEGAN

ern Russia, as she now seems to have, then Germany may be able, in time, to supply her principal needs in food, beef, animal fats, and leather; for the transportation system from Odessa to Lemberg, and thence through Galicia into Germany, is unimpaired.

HUNGER FORCES ROUMANIA TO PEACE

The Roumanians, driven back by the Germans into an unfertile corner of their country, are face to face with starvation, and are cabling to us frantically for food and clothing. Roumania has been compelled to make peace with Germany through sheer desperation, due to food shortage and to her being entirely surrounded by enemies.

In Serbia the conquering armies are living from the land at the expense of the native population, as in Poland and Roumania, the Hague Agreement to the contrary notwithstanding; and famine stalks those lands in consequence.

In the Turkish Empire, where the poor are always hungry, the officers have been allowed to speculate in foodstuffs. The limited stocks have been bought up to line the pockets of the gamblers, and prices have soared beyond the reach of

THE BOUNDARY LINES OF EUROPEAN NATIONS AS DRAWN BY THE GAUNT HAND OF HUNGER

the poor, who have been reduced for more than two years to charity rations and starving conditions.

Added to these appalling conditions, the Germans have stripped most of the factories in the conquered countries of their raw material, thus depriving the industrial classes of their sole means of livelihood. Picture the despair created by this paranoiac action that has first robbed its victims of all their capital, then, by supporting the conquering hordes on the scant native food supplies, forced upon the inhabitants the most hideous of all forms of suffering—starvation—and then used their starvation to break up families, deporting members to reinforce the depleted industrial ranks of the aggressors; and finally has drawn around this suffering of thirty millions of innocent victims a steel curtain, so that the world cannot look on to sympathize or relieve, and you have a sum total of mental and physical anguish that staggers the senses.

THE DARKEST PAGE IN HUMAN HISTORY

Nothing to compare with it has ever happened before in the history of the

PRUSSIAN SOLDIERS STRIPPING POLISH HOMES OF FOOD

"In Poland the conquering armies of the Huns are living from the land at the expense of the native population, the Hague Agreement to the contrary notwithstanding; and famine stalks that land in consequence."

human race; this is the havoc that blackens the map of Europe, and it has been wrought deliberately by a single nation to further its own ends. For the last three and a half years the most powerful weapon in Germany's hands to complete the abject subjugation of her victims has been a food shortage.

It will take generations for these famine-stricken countries to recover from the losses suffered in this period, to say nothing of the hopelessness of their outlook resulting from the almost complete destruction of their property by the Central Powers. They have been robbed of their homes, live stock, and their agricultural implements. Their factories have been pillaged, many destroyed, and the raw materials shipped to Germany.

In a word, the ravages of war, as waged under German leadership, plus the ravages of famine, which in this case is the direct result of war as waged by the Central Powers, have well-nigh crushed

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FORTUNATE ARE THESE FORLORN FRENCH PEASANTS TO HAVE EVEN A JUG OF WATER AND A CRUST OF BREAD AFTER THE HUNS HAVE STRIPPED THEIR LAND

Not content with supporting their conquering hordes on the fruits of northern France, which they overran, the Huns in their retirement destroyed the civilian inhabitants' means of securing a livelihood when farm houses, farm implements, and smiling orchards were ravaged beyond redemption. To the left is seen a veteran of the valiant French army invalided home because of the loss of a leg.

Photograph from Serbian News Service

THESE SERBIAN CHILDREN OF TRAGEDY HAVE WITNESSED THE ASSASSINATION OF THEIR HOMELAND

A scene in Belgrade after its occupation by the Austrians. Mr. and Mrs. Edward Stuart, of the Serbian Relief Commission (American Red Cross), are surrounded by orphaned waifs of a land which was first conquered by the sword and then starved to death

most of the smaller nations of Europe, leaving the peoples of Poland, Belgium, northern France, Serbia, Roumania, and Armenia without capital or hope, unless some great wealthy nation comes to their rescue after the war.

If the war continues another year, the belligerent nations of Europe will be so impoverished that for the next generation there will be a wild scramble among them to get on their own feet—a fierce, uncompromising commercial war, for which Germany has already laid the most elaborate plans.

THE PART FOOD PLAYS AT THE FRONT

What part is food playing on the other side of the battle lines with our associates in the war—England, France, and Italy?

Italy, although torn by political intrigue, might not have lost in two weeks all the ground her armies had gained in two years but for the fact that there were serious food riots in several of her principal cities immediately preceding the retreat last fall. The Austrians captured 400,000 tons of wheat and several of the most important Italian sugar refineries. If they succeed in taking the northern valleys before May, they will have a large part of the sugar crop of Italy and most of the refined sugar.

Italy is still very short of food, chiefly sugar and wheat, in several districts, and her needs must be supplied by imports if she is to continue in the war. Italy's fuel is practically exhausted—coal is $140 per ton—and as there is scarcely enough to supply the railroads, an unequal distribution of the foodstuffs in the country has resulted.

In France, the cereal crop in 1917 was less than 40 per cent of the pre-war average; but since before the war France was obliged to import 30 per cent of her food, she will require 60 per cent this year. France, because of the abnormal uses for her transportation facilities, shows a very unequal distribution of foodstuffs, so that in some districts today the people are living from hand to mouth, practically on cereals. France has large areas that are entirely without native wheat, because of the killing of the winter wheat last year. She is also very short of animal fats and dairy products.

England is fortunately more nearly self-supporting, thanks to a large potato crop; but even England must have meat, animal fats, sugar, and some wheat. She is today getting 65 per cent of her total food supply from America.

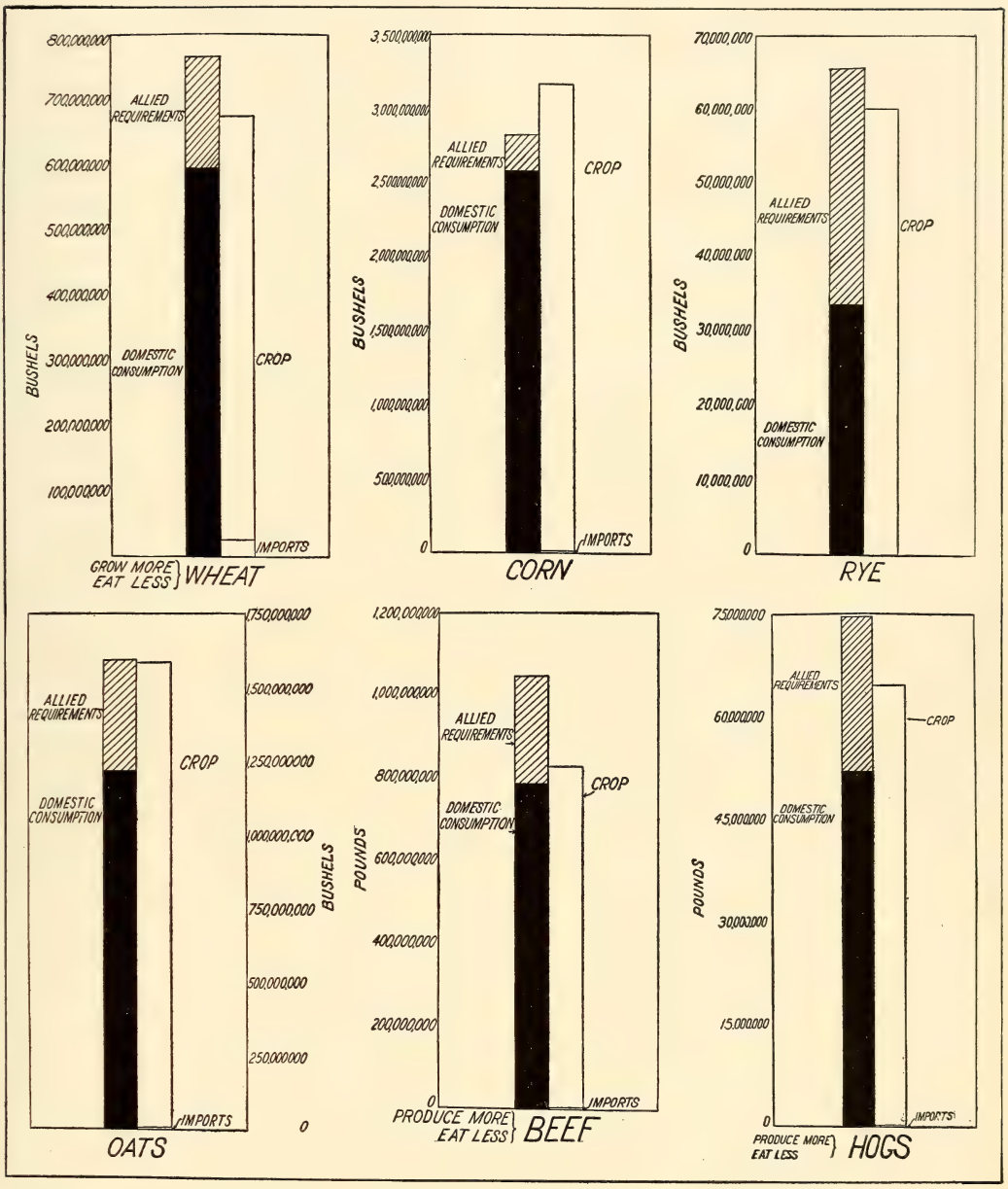
CONDITIONS IN GERMANY

In Germany, the industrial conditions show marked deterioration. Germany is reported as gradually failing. Her shipments of coal to neutrals are only 60 per cent of what they were a year ago, which means that she is having difficulty in maintaining the output of her mines. Labor is getting more scarce. The timbering for the mines is more difficult to secure; it has come largely from Sweden and Poland. The mining output is falling off, while the internal uses for coal are increasing.

Judging from statistics available here, the output of iron and steel is also falling off. No non-essential industries are allowed to run, and the quality of all manufactured articles that come from Germany is inferior to the quality at the beginning of the war. Her steel rails are not as good as they were, because there is a shortage of nickel; her rolling stock and transportation equipment are visibly breaking down.

In foodstuffs, Germany is on the whole rather better off than a year ago. She has more grain; she is exporting substantial amounts of wheat to Sweden at the present time. The flour ration has been brought up from 220 grams per capita last year to 250 grams this year. Her potato crop, which in 1916 was well below the pre-war average—a total of 28,000,000 tons—was last year 34,000,000 tons. Her live-stock is sufficient to carry her through. She is well supplied with alcohol for munition works.

There was a serious failure last season in fodder; consequently she must reduce her live-stock herds and consume much less milk than last year. Her milk production, because of the failure of the fodder crop, particularly hay, is only one-third of normal. The pinch will come, if at all, next summer, partly from lack of animal fats, partly from shortage in industrial commodities, such as wool, railway equipment, and cotton. No fod-



A FOOD RESOURCES BAROMETER OF SUPPLY AND DEMAND

The black column on the left represents our normal domestic consumption. This is surmounted by the lined column representing the amount which our Allies require. The white column to the right represents the crop resources available to satisfy the joint demands. As will be readily seen, in all save corn our normal consumption, plus the Allies' vital needs, far exceeds the supply. America is obligated to curtail consumption and increase production until the right and left hand columns balance.

der, wool, or cotton must get out of this country to any neutral country that borders on Germany or that has any way of reaching Germany.

Private hoarding apparently cannot be checked, as detection of it disturbs the peace of the community, which is given as the excuse in Germany for not at-

tempting to enforce the law; therefore, the rich are all hoarding, thus causing great unrest among the poor. As already indicated, they have rather more grain than a year ago, more potatoes, less milk, and, as they have killed off some of their cattle, they have rather more meat than a year ago.

GERMANY COUNTERFEITS RUBLES

Supplies from Russia will not be available for months, on account of the complete breakdown in transportation. Gold has practically disappeared from the country; and Germany, when the Russians were willing to sell, began printing counterfeit Russian money (rubles), using counterfeit dies and the identical paper that Russia had always used (which they secured from Sweden). This paper money was good for a time, but now even the Russian peasants decline to accept a paper ruble.

This spring Germany, while negotiating for peace, has adopted desperate measures for carrying on a successful offensive against England. The only important unknown factor in this struggle—assuming that there will be no serious disaffection in Germany on the part of the working people—is the English and American workingman. If he will hold and work loyally, the war can be won and the Prussian system eliminated from the world. It behooves America to wake up and act quickly.

PROBLEMS OF FOOD CONTROLLERS

The United States must export ninety million bushels of wheat from our present supply. We already have between twenty and thirty million bushels less in this country than we had last year. What is our duty in this matter? We must send to our Allies about one-quarter of all the wheat we have left, and this must be saved by substitution; but substitution is not going to save enough.

We must teach the people of the United States actually to reduce consumption—to eat less.

The well-to-do of this country must eat less bread and cereals of all kinds; *we should eat practically no wheat for the next four months.* Self-denial and sacrifice must be our duty; they will contribute largely to the upbuilding of American life.

Food control in Europe has been tried many times, never effectively, except by Germany. Increased wages, due to the war, invariably result in increased food consumption. It is the same in this country as abroad, and is particularly marked in Italy.

Since August 10 of last year we have had nine months of food administration. Germany begins to regulate prices at the point of consumption, where the consumer takes the food from the retailers at certain fair retail prices arbitrarily set up by the authorities, who, by deduction, work back to the point of production. This invariably results in a price to the producer that is unsatisfactory and could not be forced upon him without causing a falling off in production, except in Germany, where government control is absolute.

OUR METHOD OF FIXING PRICES

In the United States we have built up the retail price in the reverse way, by starting at the point of production—that is, paying the farmer the market price and building up the price to the retailer by adding arbitrary differentials. This gives a price to the producer that will increase production because it is profitable, and at the same time eliminates speculation, hoarding, and profiteering by the middlemen, thus reaching a fair retail price, which protects the consumer.

The elimination of speculation and hoarding and the control of profiteering by government regulation are absolutely necessary in time of war, and probably would prove beneficial in normal or peace times; but arbitrarily to control prices by government authority, either at the source or at the point of consumption, invariably results in decreased production.

The most effective way to stabilize prices is to centralize buying and stimulate production without attempting to interrupt the natural economic law of supply and demand by price-fixing. Price-fixing has never been effective, except possibly in Germany, and the penalties for the pursuance of such a policy may be cumulative; but it is to be hoped that out of these experiments to stabilize

the necessities of life some method, or methods, will be found which can be adopted as a permanent governmental policy, and become one of the effective and much-needed ways of protecting the poor and mitigating the grievances that now exist between employer and employee.

THE BURDEN OF PROFITEERING FALLS UPON THE WAGE-EARNER

The Food Administration has no power to fix retail prices; but through the license system we can control to a large extent the sales to the retailer, and thus give notice to both the retailer and consumer of what the Food Administration considers to be a fair price and fair profit.

The basis of "fair profit" during the war is the pre-war profit in any given article or business. Anything more than this results in the discontent and the misery of the people, for in the last analysis the burden of unfair prices of food falls upon the working man and his family.

We have been able to support this stabilization of prices by the embargo, which has placed in our hands foodstuffs that would otherwise have gone to neutral nations, thence in many cases to Germany. This has resulted in practically eliminating speculation, hoarding, and profiteering.

WHAT THE FOOD ADMINISTRATION HAS DONE FOR US

It must always be remembered, however, that we are in an era of high wages and high costs, and the producer must be protected at all times. This is basic with all successful food administration in a democratic country, and it must never be lost sight of.

The accomplishments of the Food Administration during the past nine months have been these:

First. It has fostered what we may call the psychology of service, which is the foundation of every great patriotic movement. We have made material progress in establishing in the minds of the public the fact that the saving of food by substitution is a definite war service on the part of the individual, and this service, which comes from the individual conscience, has in a large degree nullified the increased consumption which naturally would result from largely increased wages.

Second. It has secured and made acceptable to the public a measure of government control—wheat and sugar forming the best illustrations. The power lodged with the Administration to buy and sell for government account has had a tendency to stabilize prices. The price-fixing, in the case of wheat, has given the producer encouragement to increase production, and the resulting elimination of speculation and hoarding has protected the consumer.

Thus, in spite of a short supply—there was a serious shortage in August, September, and October, 1917—the wholesale price of flour per barrel has been reduced $3, whereas without the Food Administration flour might easily have gone to $25, or even $30, per barrel during this danger period.

The direct result of wheat control has been the protection of the price of bread by setting up arbitrary differentials, and the price of wheat bread—the working man's staff of life—has been brought down. The price of bread throughout the United States is today 30 per cent less than it was in July, 1917, the month before the food bill was signed, and only 30 per cent more than the pre-war price, although the farmer is getting a price for his wheat that is 109 per cent above the pre-war average. Thus it will be seen that the consumer has 79 points in his favor as a result of the elimination of speculation, hoarding, and profiteering—a good result which could only have been attained by government control.

THE HOG AND CORN RATIO 13 TO 1

Third. Something has been accomplished in the matter of meat control. Beef control, it is true, has not been attempted, except through the encouragement of voluntary effort to reduce the consumption. When the prices of meat go up, as they invariably do in war times, the burden of consumption falls more heavily on breadstuffs, which are the cheapest form of food. Beef is now low enough. If it goes lower, the farmer will let his cattle be slaughtered indiscriminately because of the high price of feeds. Hogs have been stabilized in price by es-

HOW OUR ALLIES' FLOUR BARREL WAS FILLED BEFORE THE WAR
IMPORTED FROM UNITED STATES
IMPORTED FROM INDIA
IMPORTED FROM AUSTRALIA
IMPORTED FROM ARGENTINA
PRODUCED AT HOME
HOW OUR ALLIES' FLOUR BARREL MUST BE FILLED IN 1918
AT LEAST THREE FOURTHS MUST COME FROM THE UNITED STATES
FROM INDIA AUSTRALIA ARGENTINA
PRODUCED AT HOME

THE ALLIES' FLOUR BARREL

Owing to the destruction of shipping, until the new American merchant fleet is constructed, but little wheat and flour from India, Australia, and Argentina can be transported

tablishing a tentative price of $15.50 per hundredweight—a price arrived at by setting up the ratio between corn and hog as thirteen to one—that is, thirteen times the price of a bushel of corn gives the price per hundredweight of hog.

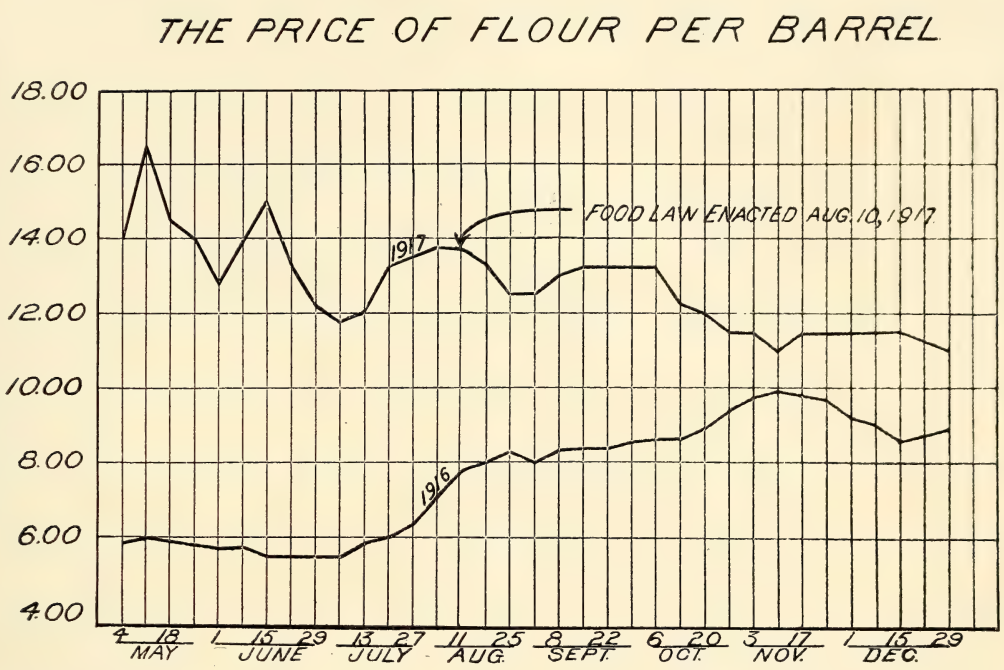
Fourth. Sugar control has been very marked. We gained little in balance on our sugar supply in the six months from August, 1917, to February, 1918. The price, however, in spite of the famine in sugar during the fall months of 1917, was brought down two or three cents per pound and held there. Congress did not give us power in our bill to buy and sell sugar; therefore we had to allow the refiners to be the purchasers with and for the Allies; but, in spite of this lack of complete power, the public has been protected and France has her sugar from our supply, sugar which we must get along without.

CONDITIONS MUST BE FACED IN WAR TIMES

War is a period of economic degeneration, so that although government control in the necessities of life may not be essential, or even advantageous in normal times, in war time we must choose the lesser of the two evils; for without control then, with prices running riot, we should face a national disaster. It is only in this way that we can make life tolerable for the working man.

Shipping is constantly diminishing. We of the United States cannot do our share in the fighting for another ten months, even with good luck. Australia has an abundance of wheat, but it takes nearly three times as much shipping to accomplish a given task of transportation between Australia and Europe as between the United States and Europe, and the situation imperatively requires that all shipping be confined to the shortest route.

If there is any falling down from now on in our proposed program for ship-building, even Argentina cannot be reached to the degree that the needs of the situation demand. It is easy, essentially, to create a new ship, as it were, by taking a ship from the Argentina service and applying it to our carrying service to Europe. Every ship we take over from the Argentina trade gives us es-



THIS CHART ILLUSTRATES HOW THE FOOD LAW, ENACTED IN AUGUST, 1917, HAS NOT ONLY SERVED TO STABILIZE, BUT TO LOWER, THE PRICE OF FLOUR IN THE FACE OF AN EVER-INCREASING DEMAND

sentially an extra ship for our European service, as the haul from Argentina to England is twice as long as that from the United States to England. The requirements of England and France in grain, as well as beef, however, call for every atom of exportable surplus now in Argentina.

PARING FOOD SHIPMENTS DOWN TO THE BONE

Because of the difficulty in reaching India and Australia, and on account of the shortage of shipping, the Allies' cereal requirements, of which they declared the irreducible minimum to be 25,000,000 tons, were arbitrarily reduced at the Allied Conference in Paris to 17,000,000 tons. We are planning to supply them with these 17,000,000 tons of foodstuffs, or approximately 25 per cent less than the Allies themselves considered their actual minimum requirements; to satisfy even this reduced schedule will tax the people of the United States severely.

Every family in the United States with any available land should endeavor to become as nearly self-supporting as possible in foodstuffs. Thousands of acres along railroad rights of way should be made available for planting to those living near, and the farmer must be protected and encouraged by State and Federal aid in prices, labor, and machinery to make the earth yield its maximum.

We must feed our associates in the war, their civilian population and ours, their armies and ours, while they fight to liberate civilization from the death grapple with a nation gone mad; and after the struggle is over and all the nations of Europe are depleted, the United States may be the only nation able to relieve the appalling needs of the innocent victims of the war now being waged by the ruthless Hun.

We were late in entering the war; for this reason we owe what we have saved to those who suffered while we delayed. Not only must we help them now, but we must lighten their burdens of reconstruction.

Such relief could be organized and administered in the form of huge govern-

Photograph from American Red Cross

YOUTHFUL SONS OF ITALY DRINKING THEIR HEALTH IN AMERICAN RED CROSS SOUP

A public kitchen scene at Palermo, where refugee children are fed daily

mental building and loan associations, to which the peoples to be relieved should contribute their fair proportion in labor and materials. Such relief would encourage, not pauperize, and, given without hope of financial or commercial gain, would strike a new note in the world's history.

We must hold firm to our ideals. We have a present and a future obligation; we must pay the full price ungrudgingly, both in fighting and rebuilding. We must demonstrate to the world the principles of true democracy, and thus hasten the dawn of a more perfect day. Then, indeed, may the hatred and bitterness of this war give way rapidly before the light of human kindness, and "Peace on earth, good will to men" become a living reality in a world where justice will reign.

AN APPEAL TO MEMBERS OF THE NATIONAL GEOGRAPHIC SOCIETY

To the Members of the
National Geographic Society:

You and the members of your household constitute three million thoughtful, intelligent, patriotic Americans. Tens of thousands of you have already made supreme sacrifices for the cause of freedom. Some of you have given your sons, your brothers, your husbands, to our country in its hour of greatest need. Others of you have given of your wealth, your plenty, your competency. Still others of you have given your time and your energy to Red Cross work, Liberty Loan campaigns, and other activities which have profited by your service and by your enthusiasm.

To those of you who already have given much there will come a special joy in the realization that there is a new opportunity for helping by personal deprivation; to those few who have not yet enlisted in the service of their country there should come a sense of relief and satisfaction that the opportunity is at hand to prove to one's self that his soul is not dead to the appeal which lies in the thought that "this is my own, my native land."

The opportunity which now presents itself to each member of the National Geographic Society is the opportunity of *pledging himself and his household to eat neither wheat bread, wheat cereals, nor pastry made of wheat flour until the new wheat crop is harvested.*

You have read the preceding article by Frederic C. Walcott, of the United States Food Administration—a simple, concise, unexaggerated statement showing that famine and starvation lie ahead of our Allies in Europe unless America is willing to practice the virtue of abstinence from that food product which is vital to the life and health of the millions across the seas who for nearly four years have suffered the horrors and the devastations of war at first hand.

America normally consumes 42,000,000 bushels of wheat each month. In order to supply the Allies with the absolute essentials of life, the American consumption must be reduced to 20,000,000 bushels a month until the next harvest.

It is not enough that you, members of the National Geographic Society, agree to use only half the wheat which you would normally consume. There are thousands, millions, of Americans who are careless, thoughtless, wasteful. They will not and cannot be made to practice such economy.

The obligation, therefore, rests upon you, who realize the situation, you, who have fortitude of purpose and the love of humanity in your heart, to do more than curtail your wheat consumption. It is not merely your duty, but your opportunity, to pledge yourself to *total abstinence* from wheat bread, wheat cereals, and wheat pastries until such time as the critical situation is relieved.

Such abstinence does not entail privation, bodily suffering, or decreased physical efficiency. Happily, there has been a bountiful corn crop. We in the United

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SHIPBUILDERS SWEARING ALLEGIANCE TO THEIR COUNTRY

"I pledge allegiance to my flag and to the Republic for which it stands—one nation, indivisible, with liberty and justice for all"

© Committee on Public Information

A NOONDAY PATRIOTIC MEETING AT A SHIPYARD

This array of smiling faces probably includes blood of every race on the globe, but they are all enthusiastic Americans, eagerly building ships to bridge the Atlantic and doing their part to make the world safe to live in

States cannot suffer for lack of bread so long as this great cereal, the staff of life for the pioneers of Colonial days, is ours in bountiful quantities.

Already the proprietors of more than 500 of the largest hotels in America have pledged themselves to the no-wheat movement, and many communities have inaugurated campaigns enlisting their citizens in the same cause.

Will you join that movement?

This appeal is to you personally, reader of this copy of the GEOGRAPHIC and member of the Society. If you will pledge your support to the United States Government and to our Allies in this crisis by eliminating wheat flour from your menu, your pledge and that of 650,000 other members of the Society will mean not merely that 3,000,000 loyal Americans will consecrate themselves to the saving of wheat for the next few months, but your influence will be felt and will be reflected in the attitude and actions of millions of other Americans.

This personal sacrifice—if sacrifice it be called—will not end with the saving of wheat. Another large and potent purpose will be achieved. The daily consciousness that you are aiding in the noblest and highest cause of modern times will bring to you an hourly renewal of determination that *America and her Allies must win the war.*

The hour and the occasion are at hand!

Do you take the pledge?

WHAT IS IT TO BE AN AMERICAN?*

By Franklin K. Lane

Secretary of the Interior

WE ARE not gathered to speak bitterly of others or to speak boastfully of ourselves. We have gathered to talk together as to the future of America and how it can be made a more nearly perfect nation.

We see clearly now what we have not so clearly seen before, that a democracy must have a self-protecting sense as well as a creative spirit.

We have lived in the full expression of the most liberal and idealistic political philosophy. There has been nothing of paternalism in our government. We have conceived it to be our high privilege to open this continent to those who came seeking the advantages and the beauties of a new land, in which the individual mind and heart could have free and full development.

The Statue of Liberty Enlightening the World at the main gateway of our country has been symbolic of our national attitude. We have believed, and we still believe, that liberty contains a magic healing power for many of the woes of man; that if we can turn its rays upon those troubles which have caused bitterness between peoples the world will be made sweeter, safer, and saner.

But in the ecstasy of our enthusiasm over the discovery of this curative agent which we had thought a panacea, we have overlooked our own responsibility. We have thought that it was enough to say, "This is a land of freedom and equal opportunity," without teaching what these terms meant. "Let us keep our hands off; let each man go his own way; let all things be thought, said, and done which each may choose to think or say or do, and sooner or later, by the conflict of minds and acts, truth will prevail." This has been our attitude, and it is one that in the long run is right.

AMERICANS OF NATIVE LINEAGE HAVE A GREAT DUTY

It is only in emergencies, such as that at present, when we realize that this attitude of *laissez faire,* of a high indifference or of a supreme faith, is a reason for self-reproach. The native Americans, those men into whom the traditions of liberty have been sunk by experience of generations, are primarily responsible

* An address delivered before an educational conference in Washington, D. C.

for whatever indifference has been shown by this nation in the education and enlightenment of those whom they have invited to these shores.

If we are to have a nation that has but one conception of national purpose, we must have that conception in our own souls in the first instance, and then we must enlighten those who come here as to what that conception is. The suppression of wrong-doing is the work of the State after the act. Courts and jails are, after all, but poor protections to a community. As a nation, we are looking for curatives, when we should long since have been looking for preventives. Modern medicine is devoting itself now not so much to the cure of ills as to their prevention. Modern statesmanship should follow the same course.

The greatest disappointment of the year has been the downfall of Russia. And yet downfall is not the precise word that should be used. The crumpling of Russia is perhaps a better expression, for I cannot believe that Russia is destroyed, and that that great nation of a hundred and eighty million people, with 7,000 miles of straightaway territory, can be crushed out of existence by the iron heel of the Kaiser, like some stray beetle. A race that is so near to its beginning cannot be so near to its end. There will be another Russia some day—a wiser, a more intelligent, a better educated, a more intensely national Russia.

The truth as we now see it is that Russia was not a nation. She had been long held together by the fear of the enemy on her western border and by the domination of a ruling class.

RUSSIA LIKE A CHILD REACHING FOR A BUTTERFLY

She had a love of freedom, but she had no knowledge of what freedom is. Her revolution, from the orderly overthrow of the Czar to the anarchy of Lenine, has been a simple and a natural process, because what she wanted was not the kind of independence, liberty, and freedom of which we know and which we cherish. It was not political power that her people sought and through which they might express themselves. Within six months after their revolution came they had degenerated into a mob who believed that liberty meant nothing less than the extreme of individualism, without a common love for anything excepting a desire to make some material gain at the expense of those who had land and lived in luxury.

Russia was like a child that reached out of the window after the butterfly, and reached so far that it fell to the ground and was crushed. She abandoned orderly processes within her own country and abandoned her allies on the outside.

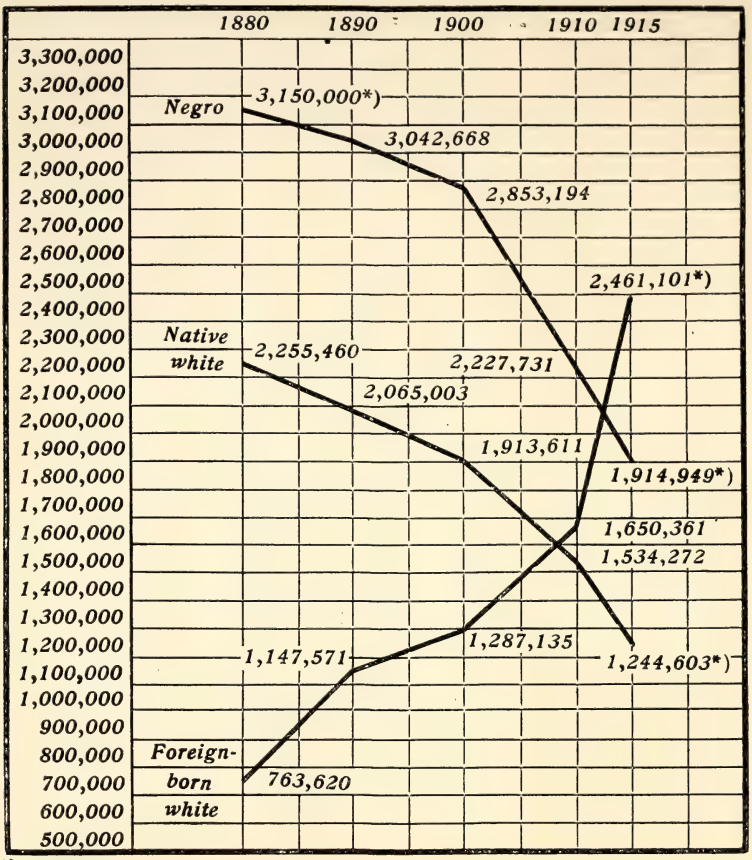
Because she was young, she did not realize that it takes time and a common purpose to make a nation, and she threw her present chance of nationality away. She resigned herself to the control of a group who believed that there was but one thing in the world worth struggling for, and that was the establishment of a new economic order, and this group undertook to compel that order by methods as ruthless as those that have filled Siberian prisons. Russia broke when her constitutional convention was dissolved by force.

RUSSIA'S UNPRECEDENTED SUFFERINGS

Russia was broken because her people did not know that political strength is a condition precedent to economic or social reform.

Russia was sick of war, and it is no wonder. She had called out twenty million men. All of them did not go to the front. Many of them could not be armed. But she sent wave after wave through Galicia and through Poland and through East Prussia, until six million Russians lay dead. Then her spirit broke. The word went out that a new day had dawned, a day in which justice would be done—that the land was to be free. The army resolved itself into its individual units, turned its back upon the front, and each individual went in search of that piece of land which should be his and which meant to him liberty.

Now what is the meaning of this to us? You say that Russia was the victim of German propaganda, and that, through the hundreds of thousands of



*) Estimated

CHART SHOWING THE RAPID SCALE AT WHICH OUR FOREIGN-BORN ILLITERATES HAVE BEEN INCREASING WHILE OUR NATIVE-BORN ILLITERATES HAVE BEEN DECREASING

Illiteracy among both the native white and negro population in the United States has been decreasing with gratifying rapidity for 35 years, but the number of foreign-born illiterates has been increasing alarmingly, especially from 1910 to 1915.

German and Austrian prisoners, the control of Russian industries, the sympathy of the Russian property-owning class, through the insidious and devious means of suggestion now being so clearly revealed, there came Russia's break-up. This may have been true superficially, but not fundamentally.

The cause of the Russian disaster, the reason that she has deserted that eastern front and has thrown the whole burden of supporting civilization upon us in the West, is the ignorance of the Russian people, 80 per cent of whom cannot read or write, none of whom, practically, had ever participated in the affairs of their own country. They did not know Russia as a nation. They had followed their leaders. They did not know the significance of Russia's position in the world.

They did not understand what it meant to have a republican form of government, through which, by their own intelligence, energy, and aspiration, they could give Russia whatever form of life they desired she should have.

OUT OF IGNORANCE HAS COME RUSSIA'S IGNOMINY

Russia was the victim of the ignorance of her people, and out of her ignorance has come her ignominy. Her people were lovable, charitable, kindly; they had the sense of neighborliness, but not the sense of nationality. The Czar was the head of the common church, and the Czar was the leader of the people. When he fell they collapsed, because they did not have the power to visualize any other leadership.

If they had had a Washington he might have saved them, though I doubt it; for behind a Washington there must be a people who have a sense of coalescence and a sense of conservatism which keeps them from destroying themselves while attempting to make themselves.

If America is not to be Russianized—and there is no fear of that—we must put into our own hearts a truer appreciation of the things that we believe Amer-

Photograph from U. S. Bureau of Education

THE ABLEST EDUCATORS OF THE COUNTRY ARE NOW ENGAGED IN DEVISING THE QUICKEST AND EASIEST METHODS OF TEACHING THE IMMIGRANT THE LANGUAGE OF THE COUNTRY OF HIS ADOPTION

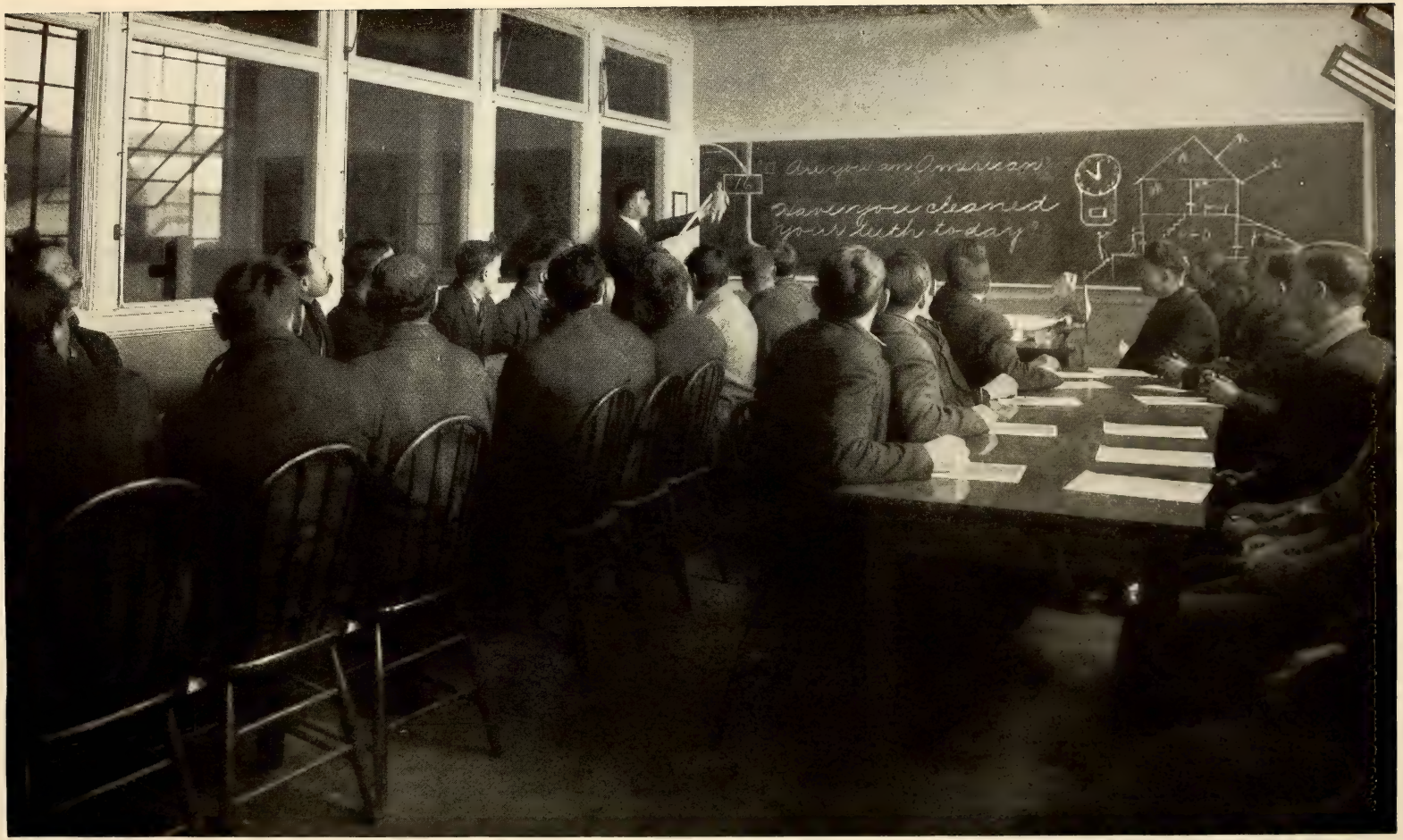
"The native Americans are primarily responsible for whatever indifference has been shown by this nation in the education and enlightenment of those whom we have invited to these shores."

ica to represent; and when we say represent we imply that we are not the exclusive possessors of Americanism. There are men in Poland, in Russia, in Spain, and in all the countries of Europe, in Germany herself, who represent the spirit of Americanism, which is, in a word, that each man shall have his chance.

What is it to be American? We say that it is to love the Stars and Stripes. But a flag is no more than a symbol. It represents hopes and fears, struggles and achievements, something done and something yet to be done.

THE REAL STORY OF AMERICA

The story of America is not to be told in the landing of the Pilgrim fathers, the fights with the Indians, Bunker Hill and Yorktown, Gettysburg and Appomattox, Santiago and Manila; nor is the story told in the advance of the pioneer from the Atlantic to the Pacific, in the building of great railroads and the conquering of the wilderness, in the searching of the mountains and the establishing of great industries, in the coming of the immigrant, or in the philosophy of Emerson



Photograph from U. S. Bureau of Education

TEACHING ENGLISH, SANITATION, AND HYGIENE TO A CLASS OF NEW AMERICANS AND FUTURE AMERICAN CITIZENS

Five and a half million persons more than ten years of age in the United States are unable to read or write in any language. There were 1,650,000 foreign-born illiterates in 1910. Five years later that number had increased to 2,461,000.

Photograph from U. S. Bureau of Education

FORTY-FOUR NATIONALITIES MERGED INTO ONE THROUGH EDUCATION

Here is a class of happy Americans. Nine months before, they knew no common language and could not appreciate or profit by the opportunities offered them in free America. Today they can speak the common language of the country and are, therefore, equipped with one of the first essentials of good citizenship.

and of James, or the poetry of Whitman and Poe, in the inventions of Whitney and Edison—not even in the lives of our great leaders.

All these are expressions of the American spirit of adventure, of purposeful searching after the thing that is better. It is an expression of a divine dissatisfaction. It may be that this nation, like all others, will come to a period of decline. We cannot expect to live forever. But if we do come to such a period, it will be because we rest content.

We are trying a great experiment in the United States. Can we gather together people of different races, creeds, conditions, and aspirations who can be merged into one? If we cannot do this, we will fail; indeed, we will have already failed.

MAKING AMERICA THE GREATEST OF NATIONS

If we do this we will produce the greatest of all nations, and a new race that will long hold a compelling place in the world. It is well, therefore, that we come together at such times of stress as this, and we should have come together long since, and put our heads to the problem as to what are the initial steps in bringing about that harmony within our country which will give it meaning, purpose, and cohesion.

We should not be moved to this by fear. There is nothing to fear. Our wars have been fought by men of foreign birth—Irishmen, and Germans, and Swedes, and Scotchmen. We see their names every day in the list of those who are dead on the battlefields of France.

There is no such thing as an American race, excepting the Indian. We are fashioning a new people. We are doing the unprecedented thing in saying that Slav, Teuton, Celt, and the other races that make up the civilized world are capable of being blended here, and we say this upon the theory that blood alone does not control the destiny of man; that out of his environment, his education, the food that he eats, the neighbors that he has, the work that he does, there can be a formed and realized spirit, an ideal which will master his blood. In this sense we are all internationalists.

SOME UNPLEASANT DISCOVERIES

Now there are several things which we have come upon recently which seem to be discoveries to those of us who have not been wise.

The first is that we have a great body of our own people, five and a half millions, who cannot read or write the language of this country. That language is English. And these are not all of foreign birth. A million and a half are native born.

The second is that we are drafting into our army men who cannot understand the orders that are given them to read.

The third is that our man power is deficient because our education is deficient.

The fourth is that we, ourselves, have failed to see America through the eyes of those who have come to us. We have failed to realize why it was that they came here and what they sought. We have failed to understand their definition of liberty.

To be an American is not to be the embodiment of conceit as to all things that are fundamental in America, or to be satisfied with things as they are, or to let things drift.

We are taking a leaf out of Germany's book in many ways these days. Our ways of war must conform to her processes of destroying human life. She has made herself a composite, compact, purposeful nation by methods of education as well as by authority. We can make ourselves a composite, purposeful nation and impose no authority, other than the compelling influence of affection, sympathy, understanding, and education.

THE RESPONSIBILITY OF THE HOUR

Out of this conference should come not a determination to make more hard or difficult the way of those who do not speak or read our tongue, but a determination to deal in a catholic and sympathetic spirit with those who can be led to follow in the way of this nation, and as to those others who cannot, other procedure must be applied. The keynote of this conference is "our responsibility."

Photograph from U. S. Bureau of Education

PUPILS "PUNCH THE CLOCK" AT THIS EFFICIENT AMERICAN SCHOOL FOR FOREIGN-BORN LABORERS AND MECHANICS

Each pupil has a card, and his school attendance record is kept with the same accuracy that his "time" is kept in the factory. This system of recording the hours spent by each man in the class-room is said to have increased the efficiency of the educational institution 100 per cent.

It is now a year since we entered into this war, and our men are standing shoulder to shoulder with Frenchmen on their right and Englishmen on their left, holding the line that is to save civilization. The war is coming nearer and nearer to us each day. Each morning we turn with anxious and with proud eyes to read the list of our own heroes who have made the supreme sacrifice.

In a few days more this list will swell from a few short inches into continuing columns and pages. Then we will first clearly see the horror of this war. And then there will surge through our souls a passion of indignation and outrage that will close our ears to talk of peace and fix our will to win.

WHERE STREAMS RUN RED WITH BLOOD

For now almost four years we have been looking afar off at a series of unprecedented battles, in every one of which more men were killed than all the joint participants in either Waterloo or Gettysburg. There is hardly a stream in northeastern France, hardly a village, that has not been given a permanent name in history as the center of a great battle.

For many days now the Germans have been advancing upon Amiens, another of the historic cathedral towns of France. This time the Kaiser himself has announced to the world that he would be present and in supreme command. There has been no such battle before. Let us hope there may never be such another.

The determination of the Germans has been shown in their unprecedented recklessness of life. Amiens, the great railroad center leading from Calais to Paris, must be seized. There never has been greater courage shown by men than the Germans have shown in this advance.

The men march in solid ranks and are mowed down by rapid-fire guns. As the front line falls the rear advances. As it falls, too, another line appears to take its place. And so by increments of death the Kaiser wins his way.

THE WORLD'S GREATEST BATTLE, BUT NOT THE LAST

This is the world's greatest battle. More men are involved, more cannon—they say there is a gun for every 40 feet along the western front—more airplanes, more tanks, more lethal weapons of every kind, more poisonous gases, and more of hell is seen upon that 60-mile front than the eyes of the angels have ever looked upon before. We call it the world's greatest battle, but the last great battle of this war has not been fought and cannot be fought now.

That line may bend, but it will not break. Remember, there are Scotchmen there—Scotchmen from Glasgow and from Edinburgh and from the far islands of the north, Scotchmen who never surrender; and Englishmen from Liverpool and Manchester and London, from the Soft Lake country and from Surrey; and Irishmen from Killarney, the gallant Irish, who are fighting that there may be an Ireland saved to which will come home rule; and men from Australia and New Zealand; Canadians, who love war no more than we do, but can make it just as well. There are Frenchmen there, the Frenchmen of Verdun. Need I say more? No more can be said.

MORE TO LIVE AND DIE FOR THAN EVER ARMIES HAD BEFORE

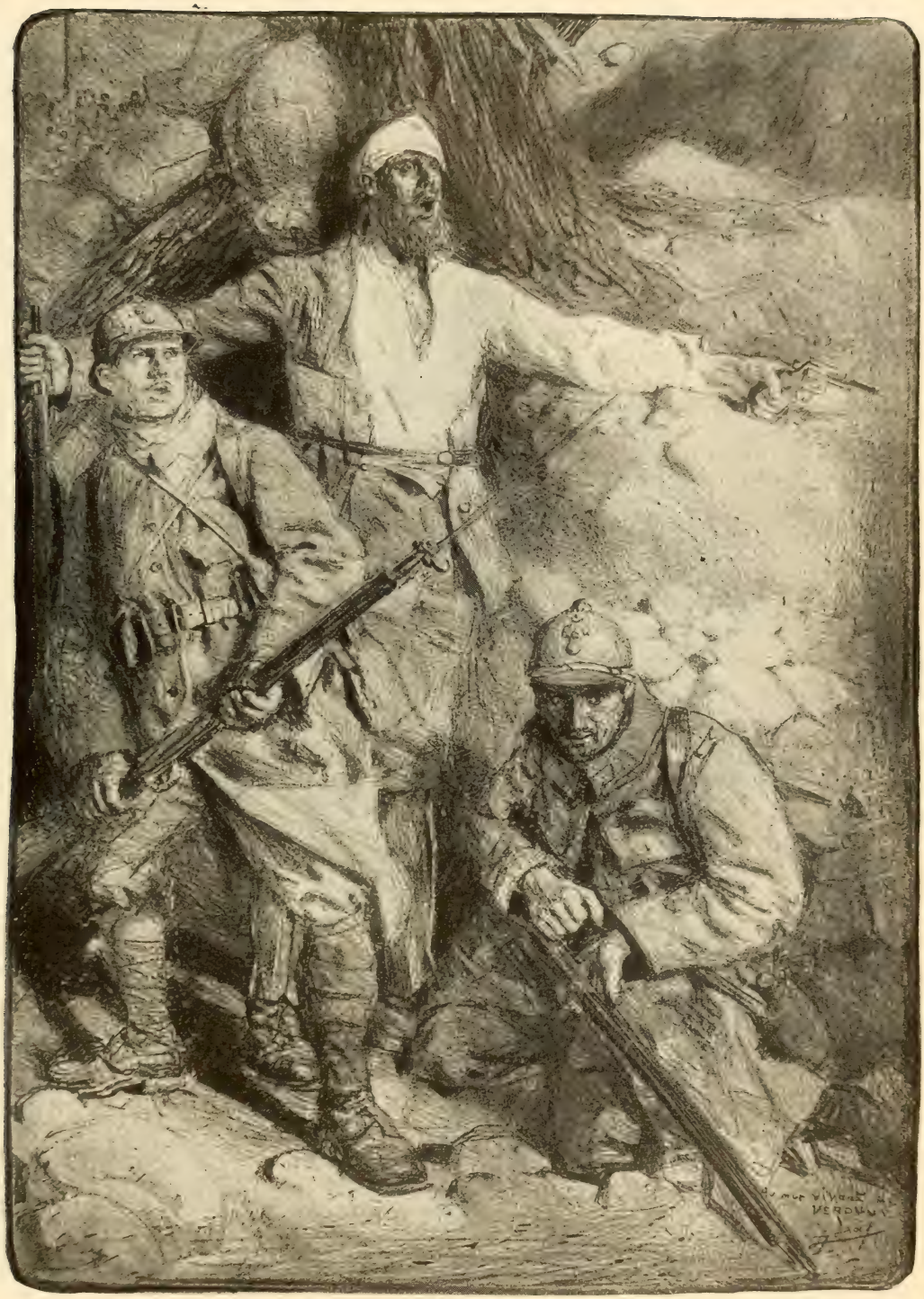
Those men do not yield. They have not fought for nearly four years that they may crumple up now. It is a thin line that holds the Kaiser back, but it is a line in which there is more of spirit and more of resolution than in any line the world has seen, because it has more to live for and more to die for than any other group of men ever gathered together; and into this thin line we are weaving our men in khaki. These are but an assurance. More and still more are to follow, until that thin line is made a thick line.

Von Hindenburg said after the first week of the offensive that the first act was over. It is never the first act that tells the story. The climax comes in the closing scene, and in that closing scene America will play her part; and it will be a noble part. It is my solemn conviction that when success comes to the Allied armies, under General Foch, it will come because of what we do, because of our men in the field, and the spirit and sacrifice of our men and women and our boys and girls at home.

A NEW SPIRIT IN AMERICA

America has never sought to be a world power. She does not now. But America has nothing to live for if Germany becomes the one dominant power of the world. And against that possible day your boys and my boy must give their lives, their ambitions, their dreams, if need be.

And we who are not permitted to fight, what shall be our part? Let it be our resolution that when our sons return they shall find a new spirit in America, a deeper insight into the problems of a striving people, a stronger, firmer, more positive and purposeful sense of nationality. We shall make America better worth while to Americans and of higher service to the world.



From the drawing by the eminent French artist, Lucien Jonas

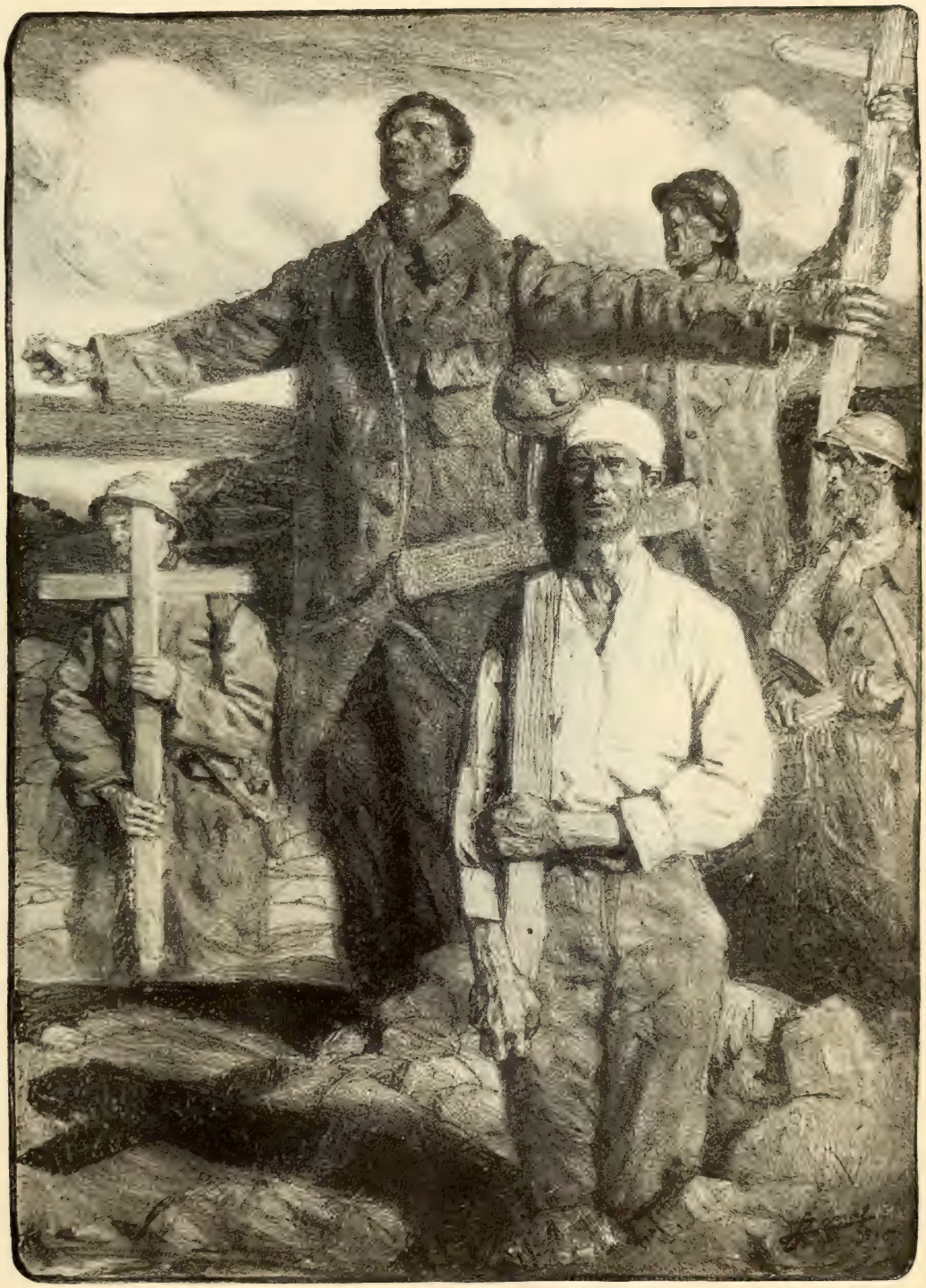
THE RAMPART OF VERDUN

Those who held the pass at Thermopylæ; the Old Guard, which died but never surrendered; Horatius and his comrades at the bridge—the deeds of these and of many other heroes of the past quicken the pulse of youth. First among the immortals of history now stand the defenders of Verdun, who said: "They shall not pass."

From the drawing by the eminent French artist, Lucien Jonas

ONE VOLUNTEER!

To carry an important message into the very jaws of death one man is needed. The remnant of a shattered company spring to attention, thus voicing the spirit of France. Which of these shall be chosen that he may give his life for his country?



From the drawing by the eminent French artist, Lucien Jonas

THE DEAD ARISEN

A dramatic conception of the fields of Flanders. The unshrouded slain of liberty-loving nations rise in protest against the inhuman invaders. The artist calls his drawing "Debout, Les Morts!"

FORMING NEW FASHIONS IN FOOD

The Bearing of Taste on One of Our Great Food Economies, the Dried Vegetable, Which Is Developing Into a Big War Industry

By David Fairchild

Agricultural Explorer in Charge of Foreign Seed and Plant Introduction, U. S. Department of Agriculture

WHEN you brand a food as not fit to eat, how do you arrive at that conclusion? If it is a food that you have never eaten before, how do you know that you are right? If it is one with which you are familiar, how do you know that the difficulty does not lie in the manner of its preparation?

It is a complicated question, this seemingly simple one of taste, and it involves the whole history of the race; and, strangely enough, it is one with which our big educational institutions have concerned themselves very little. It has required great wars to shake people's confidence in their own fixed opinions on this matter of taste in foods.

These habitudes, these tastes in foods, have been great stumbling blocks in the problem of feeding our Allies. They could not, to begin with, use our cornmeal, because they had never used it and were not accustomed to making it into corn-bread. With Madagascar and Cochin China producing great quantities of rice, the resistance to its use in certain sections of these countries has seriously interfered with the full utilization of this source of food among the Allies.

OUR LIMITED RANGE OF FOODS

It appears to be instinctive to ridicule a new flavor of any kind, especially if it is widely different from those to which one is accustomed. During the Civil War we learned to can fruits and vegetables. Does any one imagine that there were not many thousands who scorned to touch the canned stuff? It has a different taste from the fresh, and to condemn it as not fit to eat was the fashionable and the easy thing to do.

But how have we become accustomed to certain flavored foods and why are we unfamiliar with others? We eat three meals a day and in the course of our lives we sit down to the table, say, 75,000 times, and yet the range of foods with which we become familiar we can most of us count on the fingers of our hands. Why is it?

The cook-books are filled with recipes, and they are ponderous volumes, too, but they are recipes for the cooking of a few staple foods in an endless variety of ways.

The importance of possessing a wide taste in foods has never appealed to us as strongly as it should have, although Americans have made greater progress in this field of dietetics than most other peoples. We have not seen any particular advantage in it, and we have spent more money in the education of our children in art and music than in their instruction in the nutritive value of different foods.

WHY DO WE EAT VEGETABLES?

But food has come to have a new meaning, and one of the lines which this war has made plain is the dried vegetable, an old product which now has a new interest.

Why do we eat vegetables at all? They are expensive to transport on our railways, they are bulky things to handle in our kitchens, they rot easily and fill our garbage cans, and many of them require a great deal of labor to grow.

Our showmen have exhibited to mil-

ONE OF DR. MC COLLUM'S RATS, RAISED ON A PERFECTLY SATISFACTORY DIET

Note the brightness of its eyes, the smoothness of its ears, and the general appearance of sleekness of its hairy coat. This is one of the 1,500 rats which compose the laboratory of Dr. E. V. McCollum at the School of Hygiene and Public Health of Johns Hopkins University, where the dietary values of our common foods are being studied and where in particular the biological value of the different proteins which we eat is tested as to its fitness to be employed by our bodies in the building up of our body cells. It is through the researches of Dr. McCollum that the rôle of the unidentified dietary essentials, "fat soluble A" and "water soluble B," has been worked out.

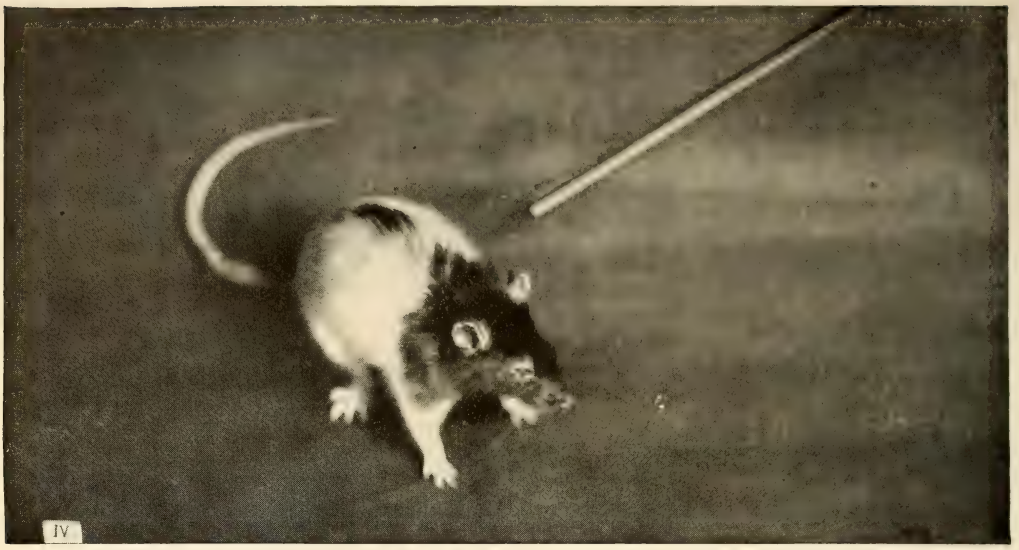
lions of Americans giants and dwarfs, fat ladies and living skeletons, but far more inspiring and educational would be the exhibition of some of those fine physical specimens of humanity from southern Italy who have lived for generations without eggs, without milk or cheese, and with meat only a few times a year. These Italian peasants, according to Lusk, have built up these strong working bodies on the simple diet of corn-meal, beans, olive oil, and the leaves of the cabbage and the beet, with garlic and Spanish peppers for flavoring.

It is these Italian peasants who for years have done the heavy construction work of our railroads, getting rich because they are willing to live on their cheap foods, while side by side with them work the Southern darkies, who have demanded meat twice a day and paid any price for it.

McCollum has shown through his rat experiments that the matter is not so mysterious as it was thought to be. The secret lay in the use of green vegetables. Rats will starve and men, too, on Indian corn alone. They will do better, although not really well, on corn and olive oil; but on corn and oil, with the addition of greens of some kind, they thrive and reproduce.

TWO NEWLY DISCOVERED FOOD ESSENTIALS

The human machine is, after all, a simple one in many ways and can take its fuel (energy-yielding food) as well from cheap as from expensive foods, but it must have all of the different kinds or it runs down quickly. Starches, fats, proteins, minerals, and water are the five great food groups for which we are accustomed to planning in our diets; but until recently we have not known about



RAT WITH CHARACTERISTIC SORE EYES, CAUSED BY A LACK IN ITS DIET OF THE "FAT SOLUBLE A"

This rat shows the effects of a diet which lacked the unidentified essential, "fat soluble A," which is abundant in butter fat, but is not found in any of the oils or fats derived directly from plants. It is present, however, in relatively small amounts in the green leaves of vegetables. Large amounts of green vegetables, therefore, particularly leafy vegetables, can be made to take the place of butter fat to a certain extent.

two others which are essential to health. They are called respectively by research men the "fat soluble A" and the "water soluble B."

The "fat soluble A" is present in the fat of milk, the butter fat which forms the cream and butter itself, but, curiously enough, is not present in the vegetable oils nor commonly in the cereals or foods coming from the seeds of plants. It is, however, a characteristic of green vegetables and is particularly abundant in the green leaves of plants.

The "water soluble B," on the other hand, does occur in cereals, particularly in their outer layers, and in green vegetables, as well as in a very large number of other foods.

The South Italian peasants build up their strong, powerful bodies, then, from the proteins and starches of their corn polenta and from their green vegetables. They get their fats from the olive oil, and their "fat soluble A" is taken from the green vegetables. Their "water soluble B" is obtained from both the corn and vegetables, for it is present in both.

The old doctrines of "strength-giving foods" must be analyzed from the new standpoint of the presence of these two newly discovered and not yet named substances, called by some the "fat soluble unknown"—substances apparently as essential to us as salt, but whose absence unfortunately we cannot detect by taste as we can the absence of salt.

THE ANALOGY OF FRESH VEGETABLES AND FRESH CEREALS

It is plain, therefore, that we must have vegetables; the trouble is that we like our vegetables fresh, and in the large cities it is becoming very difficult to have them really fresh at a reasonable price, especially in winter.

There was a time when we felt the same way about our cereal foods. We wanted them freshly ground every few days. There are men living who remember when we ate our corn-meal freshly ground, taking a bag of corn to the little mill and bringing back a bag of meal. These people declare, and I have no doubt they are correct, that there was a flavor to this meal which our modern milled product does not possess.

A RAT WHOSE DIET CONSISTED TOO LARGELY OF CEREALS AND OF FAT PORK

It was brought to this condition, approaching starvation, by being restricted to the following list of foods: wheat flour (bolted), corn meal (made of corn from which the germ was removed), rice, starch, corn grits, molasses, sugar, pork fat, sweet-potatoes, cabbage, and salt. There was too little of the leaf of the cabbage in the diet to "protect" the animal, as 95 per cent of it was derived from the endosperm (inner part) of seeds and pork fat. It is this type of diet which is widely used in regions where pellagra is prevalent.

There are some countries today where every morning the housewife roasts the coffee beans which she grinds for the breakfast coffee. If you try to convince any cook who has learned this way of making coffee that the store-ground coffee is just as good she will dispute your claim to the bitter end.

I once visited an epicure who had installed a little mill on his place, and in it every evening he ground selected seed wheat of the best quality for his breakfast cereal the following morning, and I must say that I never ate a more delicious breakfast dish.

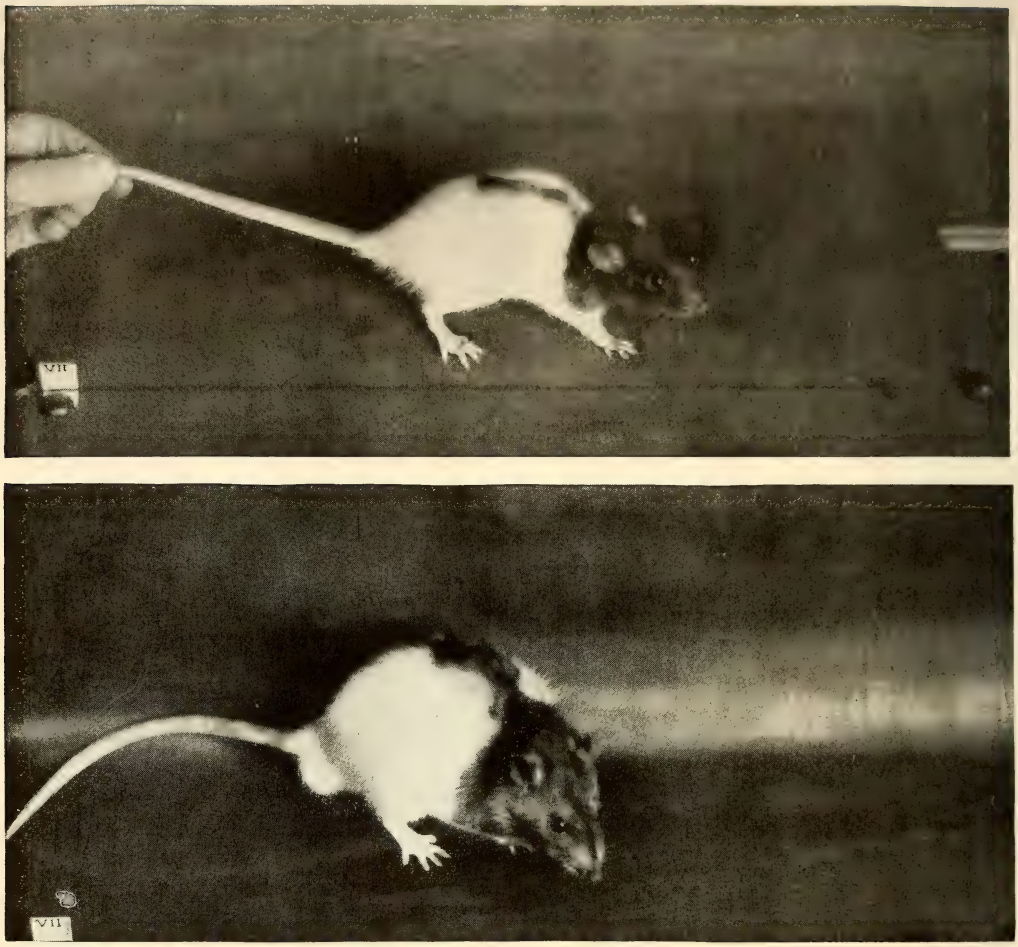
But one by one these attempts to keep close to ultra-fresh foods have broken down under the strain of increasing population; whether for good or ill is still an open question. It is no small comfort, however, to find that the more accurate researches of modern medicine and the experiments of dietitians have shown that our drift away from ultra-fresh foods is not imperiling the health of the human race.

OUR EXPENSIVE EPICUREAN TASTES

It is because we are accustomed to seeing lettuce on the table that we bring it 3,000 miles by train in special cars from California. It is just because we like fresh string-beans that we bring them, at $8 a crate, from the very tip of Florida in February, outdoing Lucullus, who brought his sterlets to Rome from the Danube by relays of runners.

And yet our bodies get no more food from string-beans at $8 a crate than they do from dried ones at a fraction of the cost, according to all the experience of Arctic explorers. The food values, according to McCollum, are not changed; the mineral constituents are all there, together with the "fat soluble A," which is not found in the grains and without which young human bodies cannot grow nor old ones maintain their vigor.

Old prejudices die hard, but we are now eating some things which our forefathers scorned or of which they had never heard. They were unfamiliar with celery and with olives. They did not dream of the grapefruit, nor the soybean, nor the wild rice of Minnesota, nor the kaffir corn, nor the cassava melon, nor the avocado, nor the banana, nor the Chinese cabbage—all these and scores more have come into our dietary within the last generation, not to mention the arrival of the whole canned fruit and vege-



TWO RATS BROUGHT TO THE VERGE OF BERI-BERI AND ONE THEN CURED THROUGH THE USE OF DRIED CELERY LEAVES

The smaller rat was fed on a diet low in the "water soluble B," and was near having beriberi. The large one was brought to the same condition and was then given 10 per cent of dried celery leaves. He gained weight with phenomenal rapidity and quickly became a fine-looking specimen, according to Dr. McCollum.

table galaxy, with its bewildering variety of flavors and colors.

THE AMERICAN'S HABITUDES ARE CHANGING

With every one saying it can't be done, the American *is* changing his habitudes, his tastes in foods.

And now the supreme moment has come to put this characteristic of the American civilization to account.

When once we learn to like dried vegetables—and if they are properly dried and properly cooked they taste so nearly like the fresh ones as to be almost indistinguishable—there will be unlocked vast storehouses of food in the sweet-potato areas of the South and equally vast supplies of Irish potatoes in the North, now threatened with complete or partial loss.

It is extremely difficult to predict the course of events in any change of human habit. Could Sir John Hawkins have dreamed, when he introduced a Peruvian tuber as a curiosity into Ireland, that his great-great-great grandchild (if he has one) would see 155,000,000 bushels of potatoes produced in that island alone?

When King John of France was being taken to England after the battle of Poitiers and one of the principal items of his expenditure was for sugar, one of the kingly luxuries of the day, could he possibly have imagined that the time would come when a descendant of a West African slave, in a continent yet undiscovered, would remark in the language of his captors, "It just seems like somebody was dead in the house to have no sugar." These are consequences of food habits.

HOW THE DRIED VEGETABLE HABIT WOULD CHANGE WORLD AGRICULTURE

To get into the habit of using dried vegetables would result in a tremendous change in the agriculture of the world. It would create demands for the products of plants which are now grown in comparatively restricted areas, and these areas would extend, just as the areas of the sugar-beet, which in Napoleon's time were small, have grown until they cover vast regions of the globe—675,000 acres in America alone.

The sweet-potato is one of the plants which would be affected at once, for its limiting factor of cultivation is its poor keeping quality and the fact that it rots if exposed to a temperature below 45 degrees. It already ranks second among the vegetables grown in this country, notwithstanding its perishability.

Dried sweet-potato slices form one of the most successful of all dried vegetables, for they "come back" when soaked, retain their sweetness and flavor, and can be fried or candied in a most appetizing way. The longing of our Southern boys in France for their favorite vegetable can be easily met by the use of these dried sweet-potato slices.

Were adequate plants erected where they would be able to turn this extremely perishable food into such an imperishable one as sweet-potato flour, in a manner comparable to the great Dutch white-potato mill, which is reported to manufacture into potato flour 33,000 bushels of fresh potatoes a day, it is reasonable to predict that our 953,000 acres devoted to the crop in 1917 would expand until a much larger proportion of the millions of acres of cheap cut-over land in the South suited to its cultivation would be planted with sweet-potatoes.

THE VIRTUES OF SWEET-POTATO FLOUR

While the sweet-potato has not as much protein as the white-potato, it has much more sugar—towards the close of the storage season it has as much as 27 per cent, reckoned on the dry substance. It is richer in carbohydrates, and produces flour of such excellence that the following comments have been gathered from experienced cooks who have tried it: "It makes just as good ginger-bread as any"; "Better muffins than Graham ones"; when used with corn-meal, "Delicious griddle-cakes," "The best I have ever tasted"; in whole-wheat bread, "It gave no new flavor and saved adding so much shortening"; "In pastry we found it most satisfactory."

For almost a year, the director of the Tuskegee Institute writes, the baker of the institution has saved 200 pounds of white flour a day by the use of sweet-potato flour (one-third sweet-potato to two-thirds wheat flour), and the resulting bread has not only become the favorite among the pupils, but among the citizens of Tuskegee as well.

When one considers that the sweet-potato crop takes 15 per cent less potash fertilizer than the white-potato; that the seed is much cheaper; that there are two planting seasons possible; that the yields on poor soils with little humus are large, as high as 100 bushels—even 700 bushels are recorded; that it grows in the region of our cheapest labor, and that that labor understands its culture, and then combines these facts with the experience of those who have dried the sweet-potato and actually made a fine flour out of it, one is forced to the conclusion that only a demand for the dried sweet-potato product is necessary in order to establish the industry firmly.

THE WHITE-POTATO SITUATION

But the white-potato situation has proved in this present emergency an even greater problem than that of the sweet-potato, for the car shortage has been so great in Colorado, Michigan, and Idaho

that immense quantities could not be moved to the markets. Orders for dehydrated potatoes for the U. S. Army amounting to many thousands of tons and the hotel demands for potato flour have brought into existence large factories which are saving millions of bushels. Had these been started earlier, any considerable wastage would have been prevented.

Some of the best hotels in the country have tried the dried sliced potatoes, some of the best restaurants, some of the most fastidious people, some of the best cooks, and the general verdict is that when properly processed and properly cooked they are almost indistinguishable from the fresh product, either as mashed potato or when French-fried.

After most careful trials the army has learned how to use them successfully, and one of the largest navy cooking schools has reported most favorably on them. In food value, in appearance, and in flavor they are the equal of any but the potato fresh from the hill. But how many of us get them fresh from the hill?

Under these circumstances and in the face of hundreds of analyses and dietetic tests which have been made, is it the patriotic thing to wonder and hold back and hesitate as to whether we can learn to use dried potatoes?

THE POTATO'S GREAT NUTRITIVE VALUE

If we let the crop rot, the moral effect on the grower will be serious. Already there is much grumbling, and the farmer is not likely to plant as large an area to potatoes again next year. Inasmuch as the regular fluctuations of the potato yields in normal years is 25 per cent, the chances of a serious shortage in 1919 ought to worry us into activity and start the erection of drying plants which would act as reservoirs, so to speak, into which would go, as has been the case in Germany, that part of the potato crop which was not immediately salable.

Because of its great nutritive value, the potato, in some form, should never get beyond the reach of the poorer classes in our cities, and the acceptance of the dried potato is the way to insure this. By its adoption the perfectly logical practice would be inaugurated of reducing the bulk, so that six cars of the fresh product will make one car of the dried, before being hauled across the country to the Eastern cities.

One hundred pounds of fresh tubers yield about 16 pounds of dried slices, containing 10 per cent of water, and these, if ground into flour, take up about one-fifth as much space as the potatoes in their original state.

GERMANY'S USE OF THE WHITE-POTATO

It would be difficult to overestimate the gigantic rôle which the dehydrated potato has played for many years in Germany. Before the war, even, it is reported that more than 800,000,000 bushels were being dried each year for human and stock food. This is more than twice the average potato crop of this country.

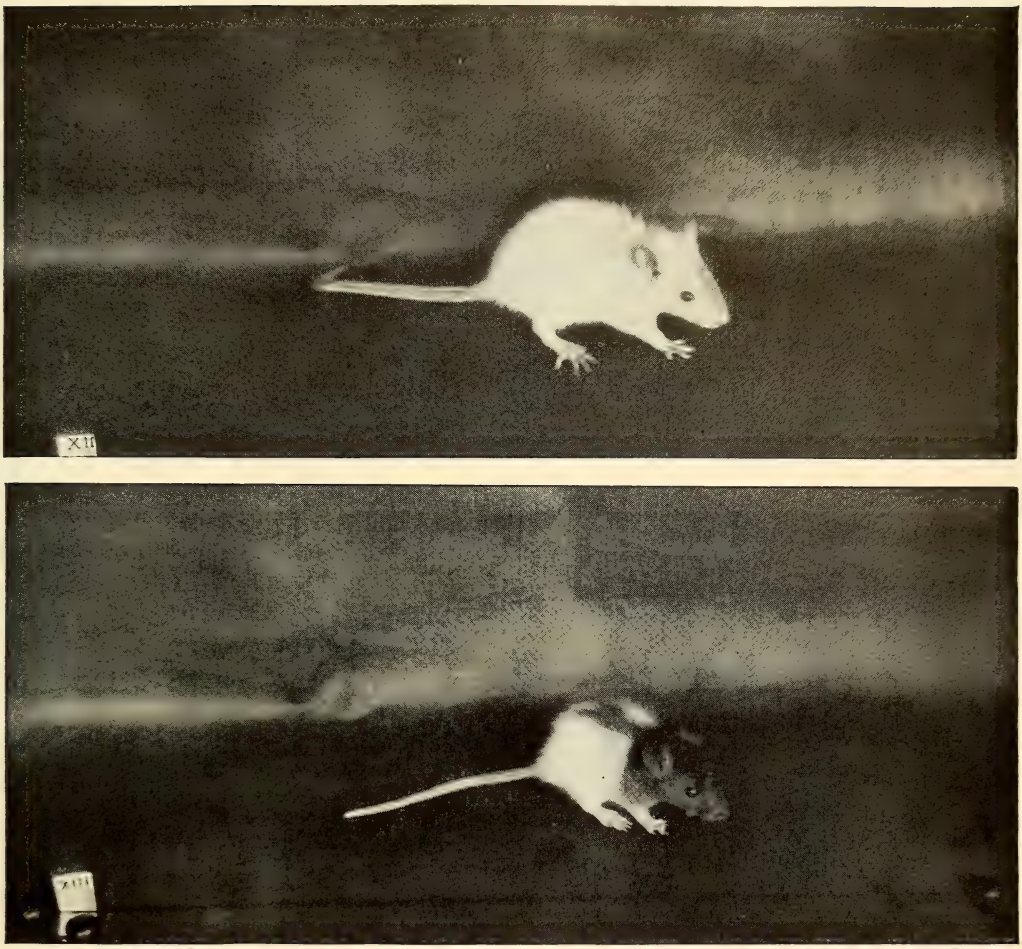
Great stocks of dried potatoes are believed to have been stored away by Germany before the war in preparation for it, and one of the first things that was done when the conflict began was to increase these factories for the making of potato flakes and potato flour. Now there are 1,350 factories devoted to potato drying alone, and practically all of the war bread used in Germany has a high proportion of potato flour in it.

Not only have the factories in Germany been increased, but the demand for potato flour has been so great that Holland has erected gigantic factories for its production.

Of course, there is no gluten in potato flour to stick it together, but the calories are there which furnish the body energy so much needed for war work. And it is important to remember that, so far as calories are concerned, an acre of potatoes will produce on the average nearly twice as much nutriment as an acre of wheat.

TWO KINDS OF POTATO FLOUR

The public should understand that there are two kinds of substances called potato flour. One is the natural potato flour, which is made by washing and slicing and cooking and then drying the potatoes and later grinding them and bolting the flour, much as wheat is bolted. This process retains all of the mineral salts.



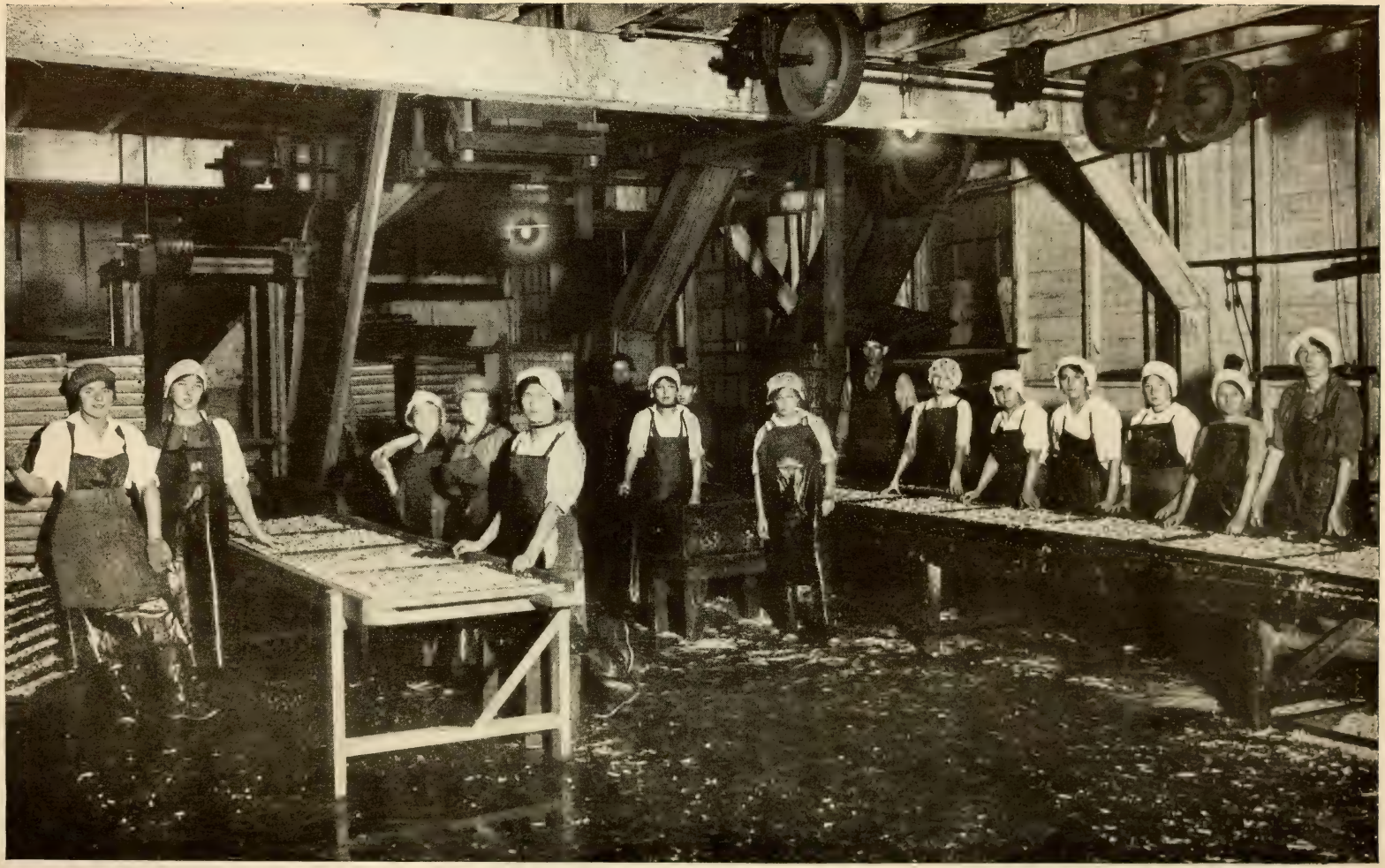
NORMAL LITTLE RAT AND STUNTED RAT

Two little rats of the same age, one normal, the other stunted by its mother's milk, which was of poor quality because of faulty diet. From the experimental cages of Dr. McCollum.

The other product is known as potato starch flour, and is made by first grinding the potatoes, pumping the pulp on a screen, which takes out the coarse fiber and skin, and then dropping this pulp into vats, where, by means of running water, all of the remaining fiber and much of the protein and mineral salts are washed out, leaving only the pure starch.

This is the starch which prior to the war was used by the cloth manufacturers for the sizing of their fabrics. Now, when wheat flour is scarce, it has come into use for the making of high-class pastries. It has not, of course, the nutritive value of the natural potato flour.

That the stabilizing of the potato crop is of the utmost importance has been recognized in Germany for many years. But in the United States the price the farmer receives varies very greatly, according as there is a surplus or a scarcity. When the potato harvest is a large one, he is apt to lose money on his crop, and, being discouraged, next year he puts in something else. If there is a shortage in that year potatoes bring exorbitant prices, and he sees big money in them, and the following year he puts in a big acreage, as do thousands of others, and perhaps the year is a good one for potatoes and the yields are 25 per cent higher, and



SCENE IN A VEGETABLE DRYING FACTORY: INSPECTING AND SPREADING TRAYS OF SLICED VEGETABLES AND LOADING KILN TRUCKS

Many tons of vegetables are daily dehydrated in this efficient Canadian plant for shipment to the British armies in France, Syria, and Mesopotamia (see also page 366)

INSPECTING TRAYS OF DRIED VEGETABLES JUST FROM THE KILNS AND FILLING TRUCKS FOR STOCK-ROOM

The concentrated food value of dehydrated vegetables was demonstrated recently in an army test, when five pounds of dried cabbage formed a ration for 428 men

again he is deceived and loses out financially.

A permanent market for potato flour in the United States would stabilize potato growing and make it less of a gamble than it is now.

THE ADVANTAGES OF THE DRIED TOMATO

But the tomato offers an even stronger argument for dried vegetables than the sweet-potato or the white-potato, when viewed from the newer standpoint of food value and car space. Fifty years ago we refused to eat the tomato because we believed it was poisonous; then we became so fond of it that we demanded it both in and out of season, even though it had to be grown thousands of miles from our markets, in the South or under glass. And for our epicurean tastes we paid exorbitant prices.

Then we learned to can this vegetable in great factories, and because we want our tomatoes stewed instead of as a sauce for macaroni or rice, we insist that the vast majority of our put-up product shall be in form for immediate use—emergency ration shape; in other words, canned without being concentrated into paste, which is the way the Italians use their tomato flavor. In this dilute form 360,000,000 cans of tomatoes are shipped over the country.

There are 2 pounds 1 ounce of tomatoes in a can, or a trifle over 1.8 cents' worth, and in a case of 24 cans, which sells for $4, approximately 43 cents' worth of tomatoes as picked in the field.

This not only means that we ship the tin cans in which the canned tomatoes are contained, but that we first ship the same number of tin cans from the factory where they are made to the cannery where they are filled.

We have never learned and have never had to learn, until this war's necessities forced the matter to our attention, that the tomato can be successfully sliced and dried; that it retains its characteristic flavor and aroma when so dried; that when soaked in water for four or six hours it comes back and makes a delicious sauce or soup, slightly sweeter than the canned tomato. For many of the ordinary uses of the household the dried tomato is as satisfactory as the canned product.

SAVING TONS OF TRANSPORTATION

One ton of good tomatoes, after peeling, trimming, and packing in cans, will weigh approximately 2,300 pounds when crated for shipment, whereas the same quantity, when dried and boxed, is reduced to only 200 pounds, or about one-twelfth as much. In bulk the saving depends upon whether the slices are compressed or not.

If left loose in the packages, the equivalent of ten carloads of the canned tomatoes could be packed in a single car, and when the car space required for moving the empty tin cans, block tin, and packing-case materials is considered, this number of cars is practically doubled.

Likewise, cabbage and its fermented product, sauerkraut, can be dried successfully and brought back without losing their flavor. In a trial at one of the army hospitals five pounds of dried cabbage formed a ration for 428 men.

Dried carrots, beets, peas, and string-beans are practically indistinguishable from the fresh; spinach, which is so often tasteless when canned, turnips, onions, cauliflower, Brussels sprouts, mushrooms, squash, pumpkins, and parsnips—all are successfully dried, particularly so by the newer and better-regulated power-fan drying processes which have been adapted and invented by various American drying firms.

These commercial products are more uniform and of much more attractive appearance than the home-dried products, taken as a class, for the reason mainly that they are dried more rapidly, under more carefully controlled conditions of moisture and heat; and when put into water they come back to almost, if not quite, their original dimensions and appearance.

BUT HOME CANNING MUST NOT BE DISCOURAGED

Luncheons in some of the big hotels of the country have been held to test these dried vegetables; some of the foremost women in the country have been given a chance to taste them, and there has been almost universal surprise as to their palatability and their superiority or equivalence to the canned products.

This article is written for the purpose of encouraging the consumption of dried

vegetables because they are economical, *but not for the discouragement of the home canning of such vegetables as are successfully canned.* Canned vegetables, while they will cost more, will always have the advantage of the emergency ration; they require only to be warmed, and for certain recipes they will be required.

The evident advantages of purchasing dried vegetables instead of fresh vegetables are that they will save the householder the labor of preparation in the kitchen, for they are all peeled and sliced and have only to be soaked before cooking; they will lessen the weight of her market-basket by the water that has been taken out, which varies from 50 to 85 per cent, and also by the absence of the peeling and tops; they will keep indefinitely if protected from moisture and insect contamination; they will lessen her garbage; when out of season they will cost less than the fresh and much less than the canned at any time, and they will insure for the children, at all times of the year, the "fat soluble A" and the "water soluble B," both essential to growth.

It would be fortunate if the time were soon to come when the drying of vegetables by means of drying plants of suitable size, with adequate safeguarding appliances, should be a local industry wherever vegetables are grown. The result would be a stabilizing of prices of those perishables which are so often grown at a loss because of overproduction or a faulty system of distribution.

Americans demand the best, and if the dried vegetable program is to succeed, it will be through the production and dissemination of a grade of dried food such as the world has never seen before. Such quality has already been produced, and with the development of the industry discoveries are to be expected which will place this new material permanently in the grocery stores of the country.

HOME DRYING IS IMPORTANT

The above statements should not be interpreted, however, as discouraging home drying.

Their reduced bulk and their excellent keeping quality should make it possible for thousands of women experts to carry on a paying business in their own special brands of a superior quality of dried vegetables, standardizing their product and making their own reputation by doing so. Once the demand for dried vegetables is general, the commercial field is open just as it is now to home-canned products.

What is needed now, however, is concerted effort to induce the American public to use dried vegetables, really to want them, and, having once tried them, continue to use them. The demand will bring the product, and this product may be expected to improve in quality and attractiveness as the art develops, just as has been the case with every other food which American ingenuity has developed.

When fresh vegetables go too high for your pocket-book, buy the dehydrated ones, which have the same food value and are more convenient, and as time goes on the demand so created for a product which is so preëminently economical and good will become a regular part of our diet and we will not any more question the dried vegetable than we do today the canned vegetables, or the dried apricot, fig, apple, prune, or raisin. It should be remembered that we produce nearly $35,000,000 worth of dried fruits every year, and consume them in the form of apple sauce, apple pies, stewed prunes, stewed apricots, and stewed peaches.

There is yet another factor which we should consider. With the shortage of labor skilled in the handling of dairy herds, the rise in the price of grain, and the cost of dairy-product distribution, it may be necessary to cut down on the family milk supply. This economy, however, eliminates not only one of the cheapest sources of proteins, but reduces for children, especially, the "fat soluble A," which is essential to growth. Should the milk supply be curtailed the only substitute is to be found in the leafy vegetables, and to make up the deficiency we would require, according to McCollum, about 30 per cent dry weight of our food to be composed of these.

Unless these vegetables are available in dried form in the months of scarcity, some of us are going to suffer. The

Photograph from Dominion Products Company

A BIN OF MIXED DRIED VEGETABLES—CARROTS, TURNIPS, ONIONS, POTATOES, PEAS, AND BEANS—MADE ACCORDING TO STANDARD BRITISH SPECIFICATIONS FOR THE BRITISH ARMY

preparation for this emergency should be made this summer and autumn when vegetables, especially the leafy ones, like cabbage, spinach, celery, can be had by the ton for what we have to pay for a case of canned vegetables in the late winter months.

CARE REQUIRED IN THE COOKING OF DRIED VEGETABLES

There is, no doubt, much to be learned in the kitchen about the handling of dried products. They are not to be handled as though they were fresh vegetables, and they require a different treatment from the vegetables which have stood for months in the water of a tin can. The moisture has been almost entirely taken out of them, and it requires time for this moisture to be reabsorbed. This process takes from six to twenty-four hours, and cannot well be hurried.

Then the cooking should be slowly done, approximating in this respect the process of the fireless cooker. In the drying operation some of the flavor is lost, but in many vegetables there is a surplus of flavor anyway. The cabbage and cauliflower, the turnip and carrot, the tomato and onion, are strong enough to lose a little of their flavor without detriment. But in cooking, the vessels in which the dried vegetables are prepared should be kept closed and as little steam as possible allowed to escape.

The tendency to be guarded against is that of having the vegetable too concentrated—adding too little water or allowing too much water to escape in the form of steam.

The most serious difficulty which attends the introduction of the dried vegetable is not different from that which attends the introduction of any new food. The danger is that the first attempt at cooking may be unsuccessful, and this failure be taken as a fair trial and the product condemned as not fit to eat, when in reality the fault lies in its preparation.

BUT DON'T SHIFT FROM CANNING

The impression has been made, and this is unfortunate, that the proposal to use dried products means that we are asked to shift immediately and wholly from the fresh and canned vegetable diet which we now have to one composed entirely of dried vegetables. This is impracticable. What is wanted is the cooperation of the households of the country in a country-wide experiment in the utilization of these foods.

What the future holds for all of us no one can tell. What economies we may have to make are hidden by the impenetrable veil. We must send our Allies the concentrated foods. We are shifting to corn in order to send them wheat. The wholesale use of dried vegetables and of potato flour will assist us to do this. The production of thousands of tons of this form of food cannot be other than a safeguard of the utmost importance.

How is the production to be stimulated? Only by a demand for it. Let the women experiment at once with the different brands of dried vegetables on the market, and demand those that they like from the retail dealers. The supply will be forthcoming as quickly as the vegetables can be grown.

Should 100,000 intelligent women order, to be delivered C. O. D., a few dollars' worth of these vegetables from the different reputable dealers, an immense stimulus to the art would be given, and a wide test would be made which would open the way to the permanent introduction of the modern dehydrated vegetable, which is essentially a new and most economical form of food.

The following firms are in a position to furnish samples of considerable size at cost, and will send them C. O. D. to any one who writes for them. They cannot afford to send them free, as the samples must be of considerable size to furnish material for several tests:

American Companies

American Dehydrating Company, Waukesha, Wis.
Anhydrous Food Products Co., 326 W. Madison St., Chicago, Ill.
Harry Bentz Engineering Co., 90 West St., New York.
California Scientific Food Corp., Los Angeles, Cal.
Casnovia Dehydrating Co., Casnovia, Mich.
Dayton Evaporating and Packing Co., Dayton, Oregon.
The Everfresh Company, Ogden, Utah.
Farm Products Company, The Dalles, Oregon.

FIELD-WORKERS IN THE WOMAN'S LAND ARMY OF FRANCE

Wherever an acre in Flanders has escaped the torch of the invader the women of France are exerting every effort to make the farms bring forth their utmost yield. A movement is now on foot among the women of America to emulate this example of their sister farmers in Allied lands.

The Flanders Company, Detroit, Michigan.
J. H. Fowler Company, Westfield, Mass.
Fullard Drying Products Corporation, 119 S. Fourth St., Philadelphia, Pa.
E. Clemens Horst Co., 235 Pine St., San Francisco, Cal.
Dr. J. F. Kelly, Pittsfield, Mass.
Luther Manufacturing Co., Walla Walla, Wash.
Mark Process Drying Co., Chicago, Ill.
Northwest Evaporating Co., Cashmere, Wash.
Penn Yan Cider Company, Penn Yan, N. Y.
R. L. Pitcher Company, Caribou, Me.
Staps Fisheries and Packing Co., Neillsville, Wis.
Webster Products Corporation, 90 West St., New York City.
The Weiser Products Co., Weiser, Idaho.
Wittenberg King Company, Portland, Oregon.
The Williams Co., Greenville, S. C., sweet-potatoes only.

Canadian Companies

Chilliwack Evaporating & Packing Co., Chilliwack, B. C.
Dominion Products Co., Ltd., Vancouver, B. C.
Graham Products Co., Ltd., Bellville, Ont.

Community driers have been established, according to Mr. C. W. Pugsley, of the University of Nebraska, at Lincoln, Nebraska; at Belmont, Fremont, and University Place, Nebraska, and Glidden, Iowa.

It is suggested that the householders in a community cover with their first pound orders the whole list of manufacturers, and by comparing notes and samples they will soon discover which are the best for their uses.

The fact should always be kept in mind that this dried-vegetable industry is a new one, and that the quality of the product produced by the different firms varies greatly. Some are, no doubt, doomed to failure, whereas others are so excellent that they are bound to succeed. To praise or condemn all makes of dried vegetables from the sampling of a few brands is to generalize too quickly.

THE NATIONAL GEOGRAPHIC SOCIETY IN WAR TIME

By Major-General A. W. Greely, U. S. Army

THE year 1917 was one of broadened activities and of increased usefulness for the National Geographic Society. Its splendid record of an unparalleled increase in membership to 650,000 is the surest proof of the success which continues to attend its efforts to stimulate a national popular interest in the science of geography.

In its field-work, as well as in its activities for the diffusion of geographic knowledge, the past 12 months have been particularly fruitful, and its expeditions, especially the one to Mt. Katmai, the world's greatest volcano, and the Valley of Ten Thousand Smokes, have been crowned with signal success.

As an evidence of the Society's desire still further to enlarge its field of service and its sphere of helpful influence, the Board of Managers was unanimous in the wish to extend to President Wilson the invitation of Honorary Membership, the highest distinction within the gift of the organization.

It was recognized by the Board that the unexampled responsibilities of the present crisis in world history leave the President small opportunity for interests not immediately related to his executive duties, and his acceptances of honorary distinctions have been extremely rare. It was hoped, however, that the activities of the National Geographic Society along patriotic lines might have an especial appeal to the head of the government.

Happily, the President did appreciate and approve the numerous productive war-time activities of the Society, as well as its normal undertakings in the interest of the increase and diffusion of geographic knowledge. He cordially accepted the proffered honorary membership, which was presented to him in the White House on December 19, 1917, by a committee from the Board of Managers consisting of Hon. Franklin K. Lane, Secretary of the Interior; Brigadier General John M. Wilson, U. S. A.; Rear Admiral John E. Pillsbury, U. S. N.; O. H. Tittmann, President of the Society; Gilbert Grosvenor, Director and Editor; John Oliver La Gorce, Associate Editor; Hon. Henry White, John Joy Edson, Grant Squires, and the writer.

UPHOLDING THE HANDS OF THOSE IN AUTHORITY

President Wilson expressed his pleasure at the honor conferred and declared that his interest in scientific research had not waned, even though it had been diverted by the critical problems of the hour. He expressed the hope that in the happier days which lie before the nation he might resume his active participation in the researches of scientists and scholars.

In answer to an inquiry as to the best way in which the Society, through its 650,000 members and the millions of Americans whom it reaches regularly through its official organ, the National Geographic Magazine, could uphold the hands of those in authority during the war, the President clearly designated certain lines along which the diffusion of accurate geographic data would enlighten the American people and ultimately prove of concrete advantage to the whole world.

These suggestions, involving problems of a difficult and complicated nature, have impressed the Board of Managers as of special importance.

In determining the best methods of accomplishing these patriotic ends, as well as in carrying forward its regular work, the Society is fortunate in having the advice and assistance of many able and distinguished Federal officials charged with duties of the highest importance. Especially valuable to the Board of Managers is the active coöperation of the Secretary of the Interior, Hon. Franklin K. Lane.

GENERAL VIEW OF U. S. MILITARY HOSPITAL NO. 1, FORMERLY KNOWN AS AMERICAN AMBULANCE HOSPITAL: PARIS

It is in this hospital that the members of the National Geographic Society have established two wards of ten beds each. A third ward will probably be established within the next few weeks. Funds sufficient to maintain these beds for one year have been subscribed by the members, and in addition to financial contributions there have been numerous donations of supplies and equipment for the convalescents.

A CONVALESCENT WARD IN THE UNITED STATES MILITARY HOSPITAL, NO. 1

Many of the knitted and crocheted comforts which will be used in the National Geographic Society wards of this hospital are the handiwork of the 250 young ladies employed at the headquarters of the Society in Washington.

MR. TAFT NOW A MEMBER OF THE SOCIETY'S BOARD OF MANAGERS

The Board also feels particularly fortunate in the addition of Hon. William Howard Taft, former President of the United States, to its councils. Mr. Taft has for a number of years taken an active interest in the Society's undertakings, and for several successive seasons has been one of the distinguished speakers in its course of 20 lectures given each winter in Washington, as well as one of the foremost contributors to the NATIONAL GEOGRAPHIC MAGAZINE.

Mr. Taft succeeds on the Board the late Col. Henry F. Blount, whose loss to the Society was voiced in the following resolutions:

"In the fullness of his years, death has called from among us our colaborer and friend, Henry Fitch Blount, who for more than a quarter of a century was a member of the Board of Managers of the National Geographic Society, and for fifteen years a member of the Board's Executive Committee.

"The Board of Managers shares with the community of Washington at large the sense of loss sustained in the death of Colonel Blount. Endowed with fine judgment and keen foresight and possessed of a ripe business experience, he was a safe and enthusiastic counsellor in the tasks confronting the National Geographic Society. He will long be missed, but his lasting monument will be that he helped to lay the foundation of the Society's work so firmly that it will endure even when the builders are gone.

"*Resolved,* That this resolution be entered as a minute in the records of the Society and published in the Magazine, and that an engrossed copy be presented to the family of our faithful associate."

SERVING DINNER FROM A PERAMBULATING STEAM-TABLE IN A WARD OF THE UNITED STATES MILITARY HOSPITAL NO. 1, AT NEUILLY, PARIS

In the splendidly equipped building at Neuilly, one of the suburbs of Paris, the wounded are given every care which modern science can provide and every comfort which money can buy. It is a model base hospital.

THE SOCIETY'S RELIANCE UPON INDIVIDUAL MEMBERS

The Board of Managers of the Society relies upon the continued coöperation and support of the individual members in the furtherance of its effective service, both in patriotic endeavors and in the advancement of human knowledge.

The deep personal interest of the members in the NATIONAL GEOGRAPHIC MAGAZINE, so encouragingly reflected in thousands of letters of enthusiastic commendation and helpful constructive criticism, is a constant source of inspiration to the Board. The Flag Number in particular has been acclaimed a monumental achievement.

During the coming months the publication of many notable geographic, patriotic, and pictorial features will maintain, if not surpass, the standard set by the GEOGRAPHIC in 1917. In this connection it is worthy of mention that the Board of Managers, in view of the magnificent results achieved by the four National Geographic Society expeditions to the Mt. Katmai volcanic region, and especially the success of the 1917 expedition, the thrilling account of which was published in the February, 1918, number of the Magazine, a fifth expedition is now being equipped, under the leadership of Robert F. Griggs, and within a few weeks will sail for Alaska to complete the exploration and investigation of the Valley of Ten Thousand Smokes. For this expedition the Society has appropriated $8,000.

INVESTMENTS IN LIBERTY LOANS

The members of the Society will be gratified to learn that the Board of Managers has found it possible to invest $100,000 of the organization's reserve

"TEMPERATURE LOWER THIS MORNING, NURSE?"

The splendid courage which sustains the soldier of the Allies in the field is ever manifest in the hospital, and, though the bed be one of pain, a smile greets the nurse upon her hourly round. This is a scene in one of the military hospitals in Paris administered by the American Red Cross.

funds in the Third Liberty Loan. The Society invested $100,000 in the two previous Liberty Bond issues.

In the War Savings Stamp campaign the Society not only purchased the full amount allowed by government regulations to any one institution, but also organized a National Geographic Society Hundred-Dollar Club in the National Capital, and more than 1,400 members have pledged themselves to purchase one hundred dollars' worth of War Savings Stamps during 1918.

It is also a source of pride to be able to announce that the members of the Society have responded so generously to the opportunity afforded them to equip a National Geographic Ward in the American Ambulance Hospital at Neuilly, Paris, France (now known as U. S. Military Hospital No. 1), that funds sufficient to care for 20 beds for one year have been subscribed, and it is believed that a third Geographic Ward of 10 beds may soon be assured.

Not only have there been liberal financial donations for the support of these Geographic Wards, but many members

ONCE THE DEN OF SMUGGLERS, NOW A REFUGE FOR INNOCENTS FROM THE AIR RAIDS OF THE RUTHLESS

This subterranean retreat shelters 70 children from the dynamite death rained from the sky whenever the boche flies over the British Isles

in addition have sent special gifts of equipment and supplies for the invalided soldiers. Among the most interesting of the latter have been handsome knitted and crocheted comforts, many of which are the handiwork of the 250 young ladies employed at the headquarters of the Society in Washington.

The Society owes the success and development of its important war work very largely to the energetic and well-directed labors of its Director and Editor, Mr. Gilbert Grosvenor. Under his inspiration and direction were established and equipped the National Geographic Society hospital wards in France. At home, one of the Society's buildings, Hubbard Hall, has been transformed into an auxiliary establishment of Red Cross workers, while the several hundred employees in the Society's office have been organized into a helpful band of patriotic workers, and the Liberty Loan and War Stamp subscriptions have been very large.

In an early issue of the NATIONAL GEOGRAPHIC MAGAZINE the Editor hopes to publish a description of the National Geographic Wards, written by Carol K. Corey, whose recent graphic articles from the front, "From the Trenches to Versailles" and "Plain Tales from the Trenches," have won enthusiastic praise from Geographic readers.

The months that lie ahead are pregnant with opportunities for national service and for achievements in the increase and diffusion of geographic knowledge. With the sustaining support of each individual member, the Society cannot fail to prove equal to and worthy of these opportunities.

THE SYMBOL OF SERVICE TO MANKIND

The Greatest Humanitarian Movement of Modern Times Originated in a Practical Attempt to Meet a Practical Need with a Practical Remedy

By STOCKTON AXSON

NATIONAL SECRETARY, AMERICAN RED CROSS

RED CROSS originated in a practical attempt to meet a practical need with a practical remedy. Sometimes a "movement" originates in an idea, and develops through successive attempts to put the idea into practice; but Red Cross began in practice and developed its "ideas" out of practical situations. Whimsical philosophers debate the question whether the hen or the egg "came first," but there can be no question about the precedence of practice and ideas in the origin of Red Cross.

Red Cross is perhaps the greatest humanitarian movement of modern times, which is of course equivalent to saying of all times, for humanitarianism is a thoroughly modern thing; but this particular manifestation of humanitarianism did not originate in theoretical notions of humaneness.

It began in a hospital and on a battlefield, with Florence Nightingale at Scutari and with Henri Dunant at Solferino, in actual nursing of sick and wounded soldiers in a base hospital, in actual salvage of wounded soldiers on a great and bloody battlefield. There was nothing vague or theoretical in the motive of Miss Nightingale or M. Dunant; it was as practical as rescuing a drowning man or twisting a tourniquet above a severed artery.

THE WAR CORRESPONDENT'S DISPATCH WHICH AROUSED ENGLAND

When the special correspondent of the *London Times*—he was William Howard

NATIONAL SURGICAL DRESSINGS DEPARTMENT AT ROME: SHOWING A STOCK OF SURGICAL DRESSINGS

Each morning the masses of whiteness mount ceiling high, only to melt away like snow by nightfall

Russell, probably the first war correspondent to render a great public service and win a conspicuous fame—sent despatches in October, 1854, from the front describing the deplorable conditions of the British troops in the Crimea, England was startled and aroused. Said he:

"It is impossible for any one to see the melancholy sights of the last few days without feelings of surprise and indignation at the deficiencies of our medical system. The manner in which the sick and wounded are treated is worthy only of the savages of Dahomey. . . . The worn-out pensioners who were brought as an ambulance corps are totally useless, and not only are surgeons not to be had, but there are no dressers or nurses to carry out the surgeon's directions and to attend on the sick during the intervals between his visits. Here the French are greatly our superiors. Their medical arrangements are extremely good, their surgeons more numerous, and they have also the help of the Sisters of Charity, who have accompanied the expedition."

This was in the middle of the nineteenth century—a century which, so far as England was concerned, was marked above all things by the growth of the democratic and humane idea. There had been more than twenty years of conscious reform through public agitations and parliamentary measures; extension of suffrage; one parliamentary bill after another providing for better working conditions in the factories and in the mines; for betterment of living conditions among the poor, especially with respect to women and children.

AN AGE OF "REFORMATORY" AUTHORS

A "school" of literature had sprung up, perhaps the greatest since "the spacious times of great Elizabeth," and the most popular of the many authors who were already making famous the term "Victorian Age of Literature" were those

DINING-ROOM OF THE RED CROSS CANTEEN AT THE GARE DE L'EST, PARIS

The Stars and Stripes and the Tricolor, which decorate the walls of this boon to tired troops, are indicative of the fact that all the canteens in Paris, as well as those at the front and at junction points along the lines of communication, are conducted under the joint direction of the American Red Cross and the French Government or the French Red Cross.

who were most humane, most "reformatory"—Dickens, Carlyle, George Eliot, Ruskin.

Dickens in particular had captivated all England with his humanity as well as with his humor, equally notable as humorist and humanist, and, best of all, basing an incorrigible optimism on the brave assumption that human misery is not "in the nature of things" and therefore unavoidable, but contrary to the nature of things and therefore remediable.

In one fascinating novel after another he had thundered this doctrine, all the more appealing because uttered in tones of hilarious laughter, the doctrine that if society would bestir itself society could cure its own evils; that where there is a will there is a way.

Never before, and perhaps never since, has a program of reform been so engagingly and so convincingly promulgated. Literati and statesmen, ordinary readers and ordinary voters, all alike were convinced that the world was well on its way to a vast betterment through society's intelligent determination to take charge of its own affairs.

Then the articles in the *Times* broke suddenly and rudely in on this optimism. Here were British soldiers of the nineteenth century suffering like the soldiers of the dark ages or of "savages of Dahomey." England's age-long military tradition combined with her new-found humanitarianism to stir the whole nation into angry protest. Something must be done! But what?

TWO PEOPLE SAW THE THING TO BE DONE

Fortunately alike for the immediate crisis and for the larger future, there were two people in England who saw clearly the thing that should be done—Mr. Sidney Herbert, one of the Secretaries of the War Department, and Miss

RECREATION ROOM OF ONE OF THE AMERICAN RED CROSS METROPOLITAN CANTEENS FOR FRENCH SOLDIERS

Coöperating with the French Army, one of the first activities of the American Red Cross in France was the organization of canteens, rest stations, and sleeping quarters for men on their way to and from the fighting front.

Florence Nightingale, then thirty-four years of age, born to considerable wealth and surroundings of superlative culture and refinement, but who had already devoted herself to the mission of developing a more intelligent system of public nursing—a woman of extraordinary ability, whose genius might have made her eminent in any one of several fields of endeavor, but who had chosen this *metier* which seemed strange to some of her friends and shocking to others.

As a young girl she had deplored the fact that the Protestant Church made no provision for the training of women, comparable to that which the Catholic Sisters of Mercy obtained, and had therefore welcomed an opportunity to go to Germany and study with Pastor Fliedner in his institute at Kaiserwerth on the Rhine.

Pastor Fliedner was the sort of German that many million other Germans would be if they would only wake up from their lethargy and cast off their abominable autocracy and militarism and give their own abundant better natures "a chance"—a kind, devoted man, seeking to make himself useful by showing others how to be useful. He had established, in a modest, practical way, an institute for the training of deaconesses in connection with a hospital, a penitentiary, an orphan asylum, and a normal school for the training of teachers.

FLORENCE NIGHTINGALE'S NURSERY NOVITIATE

In comparison with her own later and so much more scientific work of training nurses, Miss Nightingale found the nurse-training feature of the Kaiserwerth School crude and inadequate; but here she found mental and spiritual stim-

A CUP TO CHEER THE WOUNDED SOLDIER ON HIS ROAD TO RECOVERY

In the refreshment hall of an evacuation hospital scenes such as these are almost hourly occurrences, as men who are not seriously wounded are dismissed. The evacuation hospital is the institution through which the men customarily pass on their way to the base hospital.

ulation and many practical hints for her later career.

Above all, here she found what she had been seeking all through her passionate and purposeful girlhood—a way to be "of service to God" by being "of service to man." Intensely religious from childhood, she had never been satisfied with a religion whose chief object was the saving of her own soul. *Laborare est orare* might have been her motto, and here at Kaiserwerth she found a means of translating prayer into work.

Her novitiate ended, she returned to England and began the practical task of hospital nursing. She encountered many obstacles—some of the most stubborn from loving friends still opposed to what seemed to them the quixotic throwing away of a dazzling social career for the drudgery and meanness of hospital life.

That the brilliant Florence Nightingale, whose social gifts fascinated people of genius in letters and diplomacy, should deliberately ally herself with the Mrs. Gamps of the then humble, despised, menial, and frequently dissipated public-nursing service, seemed nothing less than an atrocity. But Miss Nightingale was as determined as she was brilliant and pursued her way in spite of opposition.

The point which sentimental biographers of Florence Nightingale miss is, that with all her gentler humane qualities she was like the sternest men of action in her will and purpose. Merely being "good" and "sweet" would never have carried her over her difficult road. Frequently she had to be hard, in the better way of hardness, the way of all great leaders and organizers and aggressive fighters against tradition and inanition.

A REMARKABLE COINCIDENCE

She was preparing to organize a school for nurses, modeled in part on the Kaiserwerth plan, when Russell's article ap-

SERVING A HOT MEAL TO WEARY SOLDIERS IN THE GARE DE L'EST CANTEEN, PARIS

There are three types of canteens operated or subsidized by the American Red Cross in France. The first is known as the Rolling Canteen, just behind the front line, where hot drinks, bouillon, lemonade, and mint are served to the men who are fighting or working close to the firing lines. The second class is known as the Line of Communication Canteen. In four canteens of this class 88 American women serve 20,000 soldiers daily. The third class of canteen is known as the Metropolitan, established in the principal railway stations of Paris.

peared in the *Times*. She had an intimate personal acquaintanceship with Mr. and Mrs. Sidney Herbert, as with so many of the political, social, and literary leaders of England, and she wrote a letter to Mrs. Herbert to be shown to her husband, saying that a "small private expedition of nurses" had already been organized which she proposed to take to Scutari, and asking if governmental authority could be secured for them.

This letter crossed one from Mr. Herbert, inviting her to undertake this very task for the government. It was one of those coincidences not uncommon in the history of thought, when the same idea takes hold of different minds at the same time.

In view of the momentous results of this correspondence, it is not inappropriate to compare the coincidence with Darwin's and Wallace's simultaneous expositions of the evolutionary idea. So it was arranged that Miss Nightingale and her band of nurses should go to the Crimea in the autumn of 1854.

She reached Scutari ten days after the battle of Balaclava (which made the Six Hundred so famous) and one day before the battle of Inkerman. She had her hands full. Besides the wounded, there were the sick, and they perhaps made her chief problem.

TERRIBLE CONDITIONS IN THE HOSPITALS

The condition of the hospitals was almost unbelievable—floors and walls covered with filth, exposed sewers underrunning the hospitals and emitting their foul stench through all the wards, vermin and rats (she became so expert in rat-killing that she could slay a rodent over a sleeper's head without awakening him), sheets of tarpaulin so thick and rough

WINNING THE HEARTS OF SOLDIERS BY SERVICE

Before the establishment of canteens it frequently happened that soldiers waiting for trains at junction points would spend from 24 to 48 hours without any comforts, sleeping on the ground and getting practically no food. Now, thanks to the coöperation of the American Red Cross with the French Army, the men from the front are given wholesome meals below cost (15 cents per meal) and are provided with places to bathe and sleep.

that the poor sufferers pleaded to be left between the blankets and spared the luxury of sheets altogether.

Dysentery, typhus, and cholera were raging, and by February, 1855, the mortality had reached 42 per cent. The British army was in a fair way of being exterminated.

She had other difficulties than wounds and disease and unhygienic environment—the opposition of stiff conservative military officers, of the medical staff, and of religious sectarians. Sturdy old officers who had been wounded in the Peninsular campaign, thrown in carts on a bed of straw and who had recovered, could see no sense in all this modern flummery of ambulances and scrubbed hospital floors.

Such feminization of the army was abhorrent, and they angrily asked if they were to anticipate courts-martial held by women as the next effete step in this degeneracy.

WHAT FLORENCE NIGHTINGALE ACCOMPLISHED IN THE CRIMEA

Nor will it do to smile at this as a mere example of "British conservatism." A reading of some of the reports of our own military officers of as recent date as the Spanish-American War will reveal equivalent humors in the attitude of the stiffer sort of military mind toward the idea of women in the war zone.

What Florence Nightingale accomplished in the Crimea is a part of history—history too long and involved to be summarized in this brief article. But among the things she accomplished was this, the setting of an example of momentous consequence for subsequent events.

Among those inspired by her example

A RED CROSS SUPPER FOR WAR-ZONE REFUGEES IN THE CELLAR OF ONE OF THE GREAT RAILWAY STATIONS OF PARIS

While organized primarily to minister to the needs of French soldiers on their way back to the trenches or upon arriving from the front, the American Red Cross not infrequently acts the rôle of host to a gathering such as this in the Gare Montparnasse

was a young Swiss gentleman of leisure, M. Henri Dunant, like Miss Nightingale, of gentle birth and some fortune (afterward lost, so that his days ended in poverty).

On June 25, 1859, Dunant came upon the battlefield of Solferino, littered with the dead and the wounded of the Italian, French, and Austrian armies—a total, it is said, of 91,243 victims, including three field marshals and nine generals—the bloodiest battle since Waterloo and previous to the holocausts of the present battles of Europe.

Most of the medical corps of the armies had left the field, as regulations compelled them to, to accompany the retreating and pursuing armies. Dunant organized bands of volunteer helpers and transported the wounded to the neighboring village of Castiglione, where he housed them in hospitals and churches and wherever shelter could be found.

Afterward he wrote a book of his experiences, the most famous book in the annals of Red Cross—*Un Souvenir de Solferino*—a vivid description of what he saw and what he and others did. His assistants were the civilians of the neighborhood—women and children and some men.

He tells how the women of Castiglione went about ministering to the wounded without distinction of nationality, crying "Tutti fratelli!" seeing all suffering men as brothers, no matter under what standard they had fought.

The full account of all the anguish relieved by Florence Nightingale and Henri Dunant is written nowhere, unless it be in the book of the Recording Angel, of the thousands of dying men made more comfortable in dying and of wounded and sick men saved from dying.

THE RED CROSS SPIRIT BORN AT SOLFERINO

But the far-reaching consequence of what these two did is being written daily in the activities of the Red Cross of the present. Every Red Cross nurse, and ambulance driver, and canteen server, and surgical-dressings maker, and knitter of soldier comforts is carrying on the work begun by these two in the 1850's.

This article began with the assertion that Red Cross originated in the most practical way, but now note the supplement to that statement. Each of these pioneers—Nightingale and Dunant—derived a great idea from practical work accomplished and service rendered in the exigencies and emergencies of battlefield and military hospital.

Each was a philosopher as well as a practical person, and, indeed, no greatly lasting work has ever been done or ever will be done without some sort of philosophy lying behind it or underrunning it or growing out of it. Each of these explorers in the field of suffering planned for the future on the basis of their experience of the needs of suffering soldiers. Each might be called an advocate of preparedness.

Miss Nightingale developed the whole modern system of scientific nursing and made forever impossible the atrocities and inadequacies and absurdities which Dickens satirized in Mrs. Gamp and Betsy Brigg; to which Miss Nightingale added epoch-making work in military sanitation in her studies of the condition of the British army in England.

THE VISION AND THE PLAN OF DUNANT

Henri Dunant originated the idea of permanent volunteer relief societies in all civilized countries, which in times of peace would prepare to meet the exigencies of war and in every way possible supplement the work of the regular army medical corps, which always has been and always will be unable to deal with the misery of war unsupported by volunteer assistance.

To organize this assistance and to correlate it with the army sanitary corps, in strict and loyal subordination to the army commanders, by means of permanent societies, was the vision and the plan of Dunant.

The purpose of *Un Souvenir de Solferino* is twofold: First, to make clear and vivid the actual horrors of war, and, secondly, to suggest means by which permanent societies might be established, always working under the authority and with the consent of the military powers. "Would it not be possible to found in all the countries of Europe societies which could give voluntary aid in time of war to the wounded without distinction of nationality?" so he writes.

VOLUNTEER WORKERS IN THE KITCHEN OF ONE OF THE TWELVE CANTEENS CONTROLLED OR SUBSIDIZED BY THE AMERICAN RED CROSS IN PARIS

In the Metropolitan canteens alone nearly 3,000,000 soldiers have been fed during the last four months. Up to the present time the number of American soldiers entertained at the Paris canteens has been comparatively small, but it is constantly increasing.

His two governing ideas were *permanence* and *neutrality*. "Sans distinction de nationalité" runs through the book like a musical motif. Undoubtedly he meant more by "neutrality" than has proved practicable in the actualities of warfare. Nurses and doctors cannot be drained of their patriotism, nor is it desirable that they should be, especially when the German autocracy is the enemy. But the neutrality idea does still pervade Red Cross with respect to the actual wounded.

DUNANT'S EFFORTS BEAR FRUIT AT GENEVA

American Red Cross will, of course, render no aid whatsoever behind the German lines, as it will permit no other traitorous act of giving comfort to the enemy; but when the German soldier falls wounded within the Allies' lines, he gets Red Cross care, for he is no longer an enemy; he is only a suffering man.

Dunant agitated his ideas by speech and by visits to various courts of Europe, and the result was that, with the coöperation of the Geneva Society of Public Utility, a humanitarian organization which had existed since far back in the eighteenth century, there was held in Geneva a conference in 1863 to consider ways and means of organizing and operating allied societies of relief in all European countries, functioning through a central society with headquarters at Geneva.

This was not a diplomatic convention, but a conference of representatives of various European powers to take counsel as to methods of permanent provision for the care of sick and wounded soldiers. Ten articles were framed to govern the organization and operation of these societies and their agents in the theater of war, Article XIII stipulating that "they shall wear in all countries, as a uniform distinctive sign, the white arm badge with a red cross on it"—this being the Swiss national colors in reverse.

As a result of this conference, there was held in Geneva, in 1864, another conference, this time with diplomatic authority, for the purpose of dealing, not with voluntary societies, but with the whole question of the rights of the wounded and of the army medical corps. This resulted in the famous 1864 "Convention," or "Geneva Treaty," which wrote the rights of wounded and of those who succor them into the laws of nations.

The United States had had no representative at the 1863 Conference, but was 'informally" represented at the 1864 Convention. The Department of State expressly stipulated that the representation must be informal, both because of the American tradition of non-participation in European alliances, and especially because the United States was then engaged in a civil war and could not submit its affairs to what it feared might prove to be an outside interference.

THE UNITED STATES NOT SIGNATORY TO THE 1864 TREATY

But though the United States was not signatory to the 1864 Treaty, and though its representatives did not participate in debate on the floor of the Convention, the United States was powerful in determining the course which the Conference took and in the character of the resultant agreement, for the United States had in practical operation, working under war conditions, the first actual permanent military relief association, the United States Sanitary Commission.

What had been learned in experience by this Commission was made clear to the European delegates to the Conference by Mr. Charles S. P. Bowles, an agent of the Sanitary Commission, who had been authorized to attend the Conference in company with Mr. George W. Fogg, United States Minister to Switzerland.

Mr. Bowles wrote an intimate account of the extra-legal proceedings of the Conference, of the many conversations and colloquies held in his pleasant hotel rooms overlooking the lake: "I availed myself of all suitable occasions to impress upon the members the character and extent of the great work done, and doing, to mitigate and alleviate the sufferings of the sick and wounded—whether friend or foe—by the men and women of the United States. . . . Generally it was admitted that our people in America have *practically* solved pretty much all the questions which this international congress was met to consider."

GENESIS OF THE UNITED STATES SANITARY COMMISSION

And now the story returns to Florence Nightingale and to the British Commission which followed her to the Crimea in April, 1855. Charles J. Stille, in his "History of the United States Sanitary Commission," makes it very clear that the Commission owed its existence to the experiences of Great Britain in the Crimea!

"At that time the experience of the Crimean War was fresh in the memory of all. That experience was a complete chapter by itself on sanitary science. It taught the great truth that the 'cause of humanity was identified with the strength of armies.' We were left to no vague conjecture as to the causes which produced the fearful mortality among the allied troops before Sevastopol. . . . Public opinion in England, indignant and horror-stricken at this frightful result, long before the war closed, called loudly for investigation and remedy.

"The result has been a contribution of inestimable value to our knowledge of everything which concerns the vital questions of the health, comfort, and efficiency of armies. The results of these investigations, both in regard to the causes of the evil and the wonderful efficiency of the remedies which were applied for its removal, had been recently given to the world in parliamentary reports, in the works of professional men, and especially in the invaluable testimony of Miss Nightingale; so that all the conditions of the problem were perfectly known, and its solution could be arrived at with the exactness and certainty of a scientific demonstration."

PREVENTION THE WATCHWORD OF THE SANITARY COMMISSION

As the watchword of Dunant was *Permanence,* so the watchword of the United States Sanitary Commission was *Prevention.* The Commission originally proposed to act in an advisory capacity to the government in general matters of sanitation, but it rapidly grew into a central committee for most of the organizations of volunteer relief in the North; was in fact the first organized practical Red Cross association, though it did not bear the name. The advice of Mr. Bowles seems to have carried special weight with the delegates to the Geneva Conference in matters concerning the so-called neutralization, or inviolability of the wounded and those attending upon them.

It will interest the readers of the South to know that General Beauregard seems to have been the first officer in the Civil War to suggest the systematic and invariable recognition of the rule that surgeons should be treated as non-combatants and released if taken prisoner.

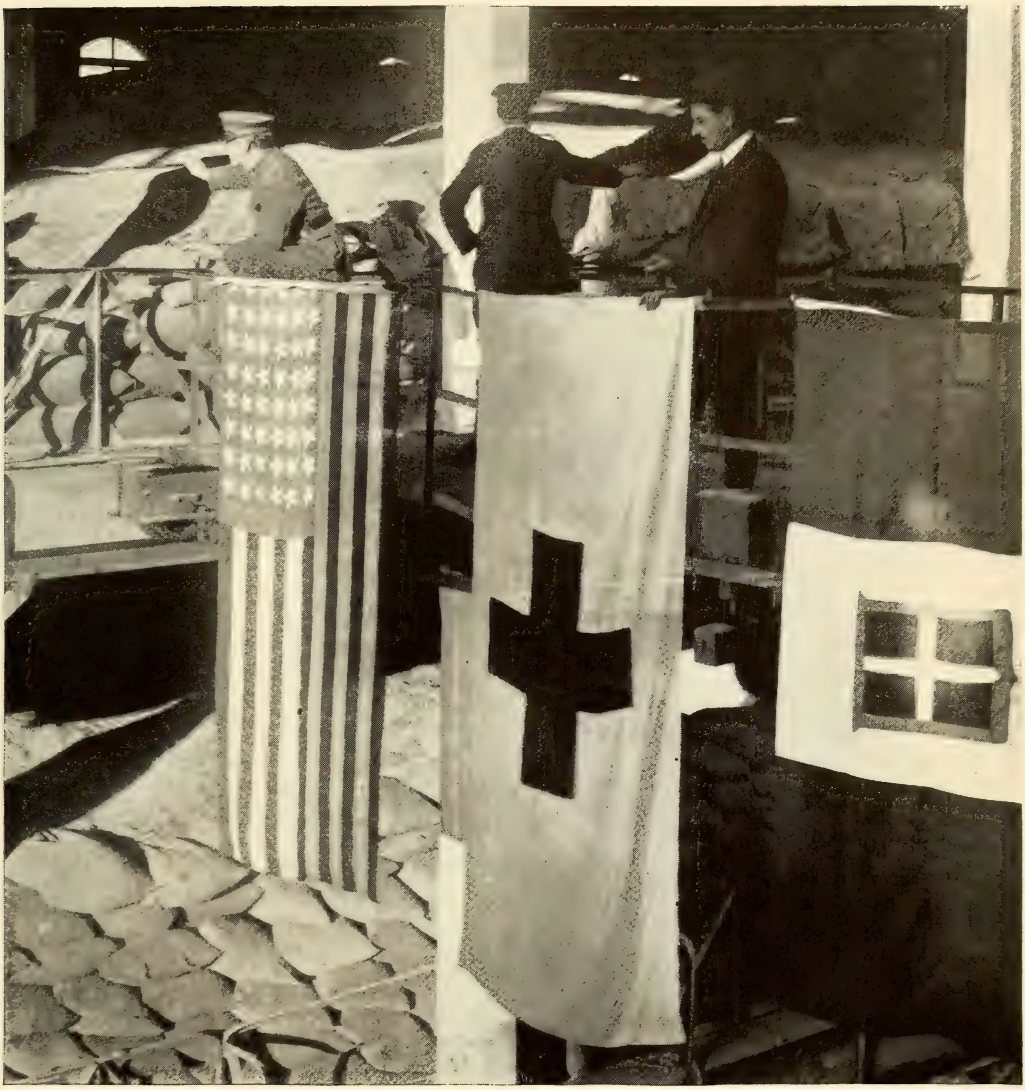
There seemed to be some question in the minds of the delegates to the Geneva Convention as to whether this so-called principle of neutrality was practicable, but Mr. Bowles seems to have been able to convince them that it had proved quite practicable in the traffic between the armies of the North and the South.

A UNIVERSAL SIGN ADOPTED FOR THE SANITARY CORPS

The 1864 Conference did not consider the question of volunteer societies—that had already been dealt with in 1863—but it adopted a "Convention" of ten articles looking toward the inviolability, or "neutrality," of the medical corps and the wounded, ambulances, military hospitals, personnel, and even the civilians within the theater of war who should render aid to the wounded, and it adopted a universal sign for the sanitary corps of all armies alike—"The flag and arm badge shall bear a red cross on a white ground."

Hitherto each nation had had its own sanitary corps insignia, usually unrecognized by the enemy, even though the enemy should have wanted to protect the medical and nursing contingents.

Such, briefly summarized, is the way Red Cross began. The history of later conventions, developments, and modifications is too long for the purpose of this article. What is being emphasized here is that a practical beginning, combined with a characteristically nineteenth century humane idea, has led to the far-reaching and manifold modern Red Cross, which has been amplified until it includes almost every conceivable activity designed to lessen human misery, not merely in the stress of war, but in great natural calamities.



UNDER THREE FLAGS IN ITALY

The Stars and Stripes and the banner of the American Red Cross hang side by side with Italy's ensign, which displays the cross of the House of Savoy, in the warehouse at Rome where Red Cross supplies are stored.

"UNTIL THE GERMAN AUTOCRACY SUDDENLY WENT MAD"

Indeed, until the German autocracy suddenly went mad (and it is comforting to remember the ancient adage that "whom the gods destroy they first make mad"), it was considered by those most concerned with American Red Cross that its chief function would be to relieve the misery incident to floods, conflagrations, earthquakes, famines, and similar natural catastrophes.

Those who were active in raising the Red Cross Endowment Fund a few years ago found that their chief difficulty lay in convincing the people of America that there was really any need of an elaborately organized war-relief society, for war seemed a remote contingency to the American people, and it was only by emphasizing the value of a permanent relief

society for those emergencies due to natural causes that the people were persuaded to contribute in any large sum to Red Cross.

But we reckoned without the Hohenzollerns. These disturbers of the world's peace have brought many changes to the American mind, among them a total change in the conception of Red Cross, its needs, and its opportunities. The immediate business of American Red Cross is to mobilize the relief agencies of America for the most destructive and the most merciless of all wars.

TWO MAIN CONCEPTIONS OF THE AMERICAN RED CROSS

In doing this it works under two main conceptions: to relieve (and, as far as possible, to prevent) the misery incident to war and to assist in maintaining the morale of the fighting forces.

To lessen the fighting man's misery and to keep him fighting—these seem, superficially, contradictory motives; but all who believe in that just peace which can be the only lasting peace know that it is superlatively important to keep our own soldiers and our allies on fighting edge until the German beast is beaten. The world will never be habitable until that is accomplished.

Red Cross is rooted in a humane idea; but the world cannot be made humane until German inhumanity has been brought to a stop; and so long as those who now control Germany remain in control, this can be done only by speaking to them in louder tones than their own, the only language which they comprehend—the language of force.

After the humane nineteenth century, we had reason to prognosticate a yet more humane twentieth century. But Germany has confused the horoscope; she has made the most astounding assault on humanity in the history of the world, welding to the brutishness of the Hun the ingenuities, resources, and cruel refinements of perfected science.

THE TUSKS OF THE PRUSSIAN BOAR MUST BE DRAWN

The first business of the civilized world is to draw the tusks of the Prussian boar, and Red Cross is exerting its utmost endeavor to serve the army and the navy in their accomplishment of that end. While Red Cross does all it can to comfort the wounded soldier, it adopts every device it can conceive to make the well soldier a better fighting man.

Hence its canteens, and rest stations, and all its coöperation with the government, with Y. M. C. A., and with all other war agencies, to render the soldier life as tolerable, as comforting, and as heartening as possible.

But it goes back of the soldier to the soldier's family. If there is any outstanding lesson which Red Cross has derived from its experiences in this war as overtopping all other lessons which it has learned, it is this: that the morale of the soldier depends almost as much on having his family cared for as on having himself cared for.

Though he be warm within and without and given every known modern device for soldier comfort, he will be at something less than his best if he is harassed with anxiety about the wife and children, the old father and mother, behind the fighting line, within the zone of war or beyond it, or even across the far-stretching Atlantic Ocean. In this conception of the complete duty which the people owe their soldiers, the Red Cross Department of Civilian Relief has become almost as much a war department as the Department of Military Relief.

CIVILIAN RELIEF WORK

That the soldiers' families may be served intelligently as well as generously, the Civilian Relief Department has organized its Home Service institutes, where workers are trained by the most modern and scientific methods to render every conceivable kind of help that is needed, including that most helpful and most delicate and most difficult of all help, the help which helps people to help themselves.

This, of course, is nothing more than the modern science of social service rendered to people as a war measure—that science which combines in a delicate and intricate way the quality of mercy with a clear understanding that mere promiscuous "charity" may be of all things the least kindly in the end.

Photograph from J. T. Dye

MASTER EDWARD T. DYE, AGED THREE AND A HALF, SELLING W. S. S. IN NEW YORK CITY

Says he is going to sell $1,000.00 worth and is making good his promise, with a band to back him up

© Underwood & Underwood

FIRST THE SCRUB-DOWN, THEN THE WAR PAINT

Before the art of "camouflage" came into existence, battleship-gray was the hue of our fighting craft in time of strife. Now the world's warships are streaked and striped blue, green, and black, to simulate the waves at a distance.

To preserve people from deteriorating through neglect, and at the same time to preserve them from deteriorating by growing dependent on the easy bounty of others, this is, of course, the primary lesson in all rational and responsible social service, and this lesson must be learned by many who would assist the families of soldiers, not sentimentally and to their destruction, but really and to their betterment. Hence the Home Service institutes which are held all over America and in which those who really wish to be of service can learn the difficult lesson of acquiring science without losing their susceptibilities to pity.

RED CROSS EDUCATIONAL WORK

This work is, of course, educational in its most far-reaching aspect, and to this work of education, Red Cross has added another in its Junior Auxiliary—a plan whereby the school children of the country are enlisted in Red Cross activity, not for the sake of their membership fees, because these fees are never applied to the general purposes of Red Cross, but are used entirely to promote the children's own activities; not primarily, either, for their production of Red Cross articles, knitted goods, etc., but primarily for the education of the children themselves in foundational principles of citizenship and the application of citizenship to war conditions.

So far from undertaking to exploit the school children of America for Red Cross activity, the Junior Auxiliary seeks rather to make Red Cross the coördinating agent of all their war activities, and thereby to save the time of the school children rather than to add an extra burden to the already too many burdens of extra-curriculum activity.

"NOTHING STANDS ALONE"

These extensive educational ventures may seem far afield from the thoughts which Henri Dunant had in mind when he and the women of Castiglione were bearing bleeding and groaning soldiers from the battle ground of Solferino, and when the thought shot through his brain that there should be a permanent organization for this sort of relief.

Certainly the idea could not have occurred to him then that this single thing that he was planning should develop into so complex a matter as the modern Red Cross, with so many ramifications and so many unsuspected opportunities translated into far-reaching duties. But this is merely an example of that great fact of the universe of which all philosophers are conscious, that nothing stands alone, but everything exists in relationship to something else and each in turn is related to all.

A wounded soldier is a very concrete fact, but when humanity has undertaken to care for that soldier it cannot stop until it has done everything that will rationally administer to his welfare. And so, step by step, Red Cross has grown in a quite logical way from physical service to a wounded man into this great complex machinery which touches the soldier's interests at every point, and which, for its true functioning, must invade the fields of education itself.

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SMALLER MAMMALS OF NORTH AMERICA

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With illustrations in color from paintings by Louis Agassiz Fuertes

This series of animal biographies and natural-color portraits is a counterpart of the series dealing with the Larger North American Mammals, published in the November, 1916, NATIONAL GEOGRAPHIC MAGAZINE. *Together they describe and illustrate the most interesting and characteristic types of North America's mammal life. The author of these intimate insights into animal nature, Mr. E. W. Nelson, for forty years the friend and student of the people of the wild, brings to* GEOGRAPHIC *readers a refreshing picture of their habits, their traits, and their environment. He has studied them from northernmost Alaska to southernmost Mexico. The paintings are by Mr. Louis Agassiz Fuertes, whose work is always received with enthusiasm by* GEOGRAPHIC *readers everywhere, and the illustrations of the animal tracks by our foremost American authority, Ernest Thompson Seton.*

IN THAT part of North America lying north of Mexico more than 1,300 species and geographic races of mammals are known to exist. Of these by far the greater number, both of species and individuals, fall into the class of smaller mammals.

Some of the most characteristic types which appear to have originated in North America are the mountain-beavers, pocket-gophers, kangaroo-rats, pocket-mice, wood-rats, white-footed mice, muskrats, skunks, and ring-tailed cats.

In Siberia and Europe live close counterparts of our northern weasels, minks, martens, field-mice, lemmings, northern hares, conies, marmots, moles, and others; and on our southern border the armadillo and the hog-nosed skunk introduce a faint tinge of a strange fauna from South America.

FURRY FRIENDS AND ENEMIES

The muskrats, minks, martens, and skunks for many years have yielded an enormous annual return from their furs; the squirrels and rabbits afford sport and a large supply of excellent flesh for food; the prairie-dogs and some of the ground-squirrels existing in enormous numbers have been excessively destructive to crops; and others, like the porcupine and the armadillo, have attracted particular attention because of their strange characteristics.

The smaller mammals live everywhere, from the tropical end of Florida to the uttermost lands of the frozen North, and from the seashore to the limit of vegetation on the high mountains. The heaviest forests, open meadows, rugged mountain slopes, arctic barrens, and sun-scorched desert plains all have their small

Photograph by Howard Taylor Middleton

HEREDITARY ENEMIES: A CAT WATCHING A GRAY SQUIRREL

At one time the gray squirrel was so abundant as to make ruinous inroads on the corn and wheat crops of our pioneers. In Ohio, a hundred years ago, there was a law requiring each free white man to deliver 100 squirrel scalps every year or pay a penalty of $3. Today the gray squirrel needs legal protection to prevent its extermination.

four-footed habitants. Many modifications of parts and organs of the various species have been necessary to adapt the small mammals to specialized modes of life.

ANIMALS THAT LEARNED TO "DIG IN"

This is strikingly illustrated in the case of those true rodents, the pocket-gophers, which apparently found competition on the surface of the ground so acute that they took the unoccupied territory below the surface, where they live as miners and tunnel from place to place in search of edible roots, with an occasional stealthy excursion above ground to seize some of the food available there.

Another excellent illustration is furnished by the moles, which, leaving the numerous closely related species—the shrews—to feed upon insects above ground, have descended and, like the pocket-gophers, live in tunnels which they make in the pursuit of earthworms and insects below the surface; like the gophers, they, too, make occasional excursions above ground in search of food.

The mink and the muskrat, representing the carnivores and rodents, have rivals for their food supply on land and have become amphibious, being as much at home in the water as on shore, one feeding on fish and flesh and the other on aquatic vegetation. Certain forms of the squirrel tribe are heavy-bodied and live in underground burrows, while other more slender and graceful species make their homes in the tree-tops.

A DEPARTURE FOR EVERY NEED

Another member of this group, the flying-squirrel, has developed an extension of the skin uniting the front and hind legs, so it may glide freely from tree to tree. The bats have gone still further, and the skin uniting their lengthened front and hind limbs and long finger bones forms broad wings which lend them powers of flight scarcely equaled by those of birds.

The gophers, pocket-mice, chipmunks, and others are provided with little cheek pouches in the skin on each side of the mouth, in which they may carry food home to their store-rooms and other hiding places.

The hares have developed long legs for running on open plains, and the weasels have long, slender bodies and an exceed-

Photograph from Ernest Elva Weir

A HAND-FED KANGAROO-RAT

These curious little desert rodents have many interesting habits, one of the most fascinating being their method of combat. Sitting on their hind feet, after the fashion of kangaroos, the belligerents hop around each other, sparring for an opening, finally striking out with their long feet like game cocks. When a kick lands fairly, the victim rolls over as if ready to "take the count."

ing quickness which enables them to follow and capture their elusive prey in its burrows and among crevices in the rocks.

The hairy coat of the mole is short and equal to the finest velvet, while that of the porcupine stands out in strong, sharp spines; the skin of the armadillo is practically hairless, but forms a bony armor covering its upper parts.

The front feet of squirrels and most other rodents are slender and used with deftness as hands in manipulating food, while those of the badger and skunk are heavily clawed and strongly muscled for the purpose of digging up their prey.

The tails of many species are varied in form to serve special purposes. The long-haired tails of tree-squirrels have a plume-like character, which adds much to the beauty of these attractive animals. The long tails of the kangaroo-rats and the jumping-mice serve as balances for their bodies during long leaps. The vertically flattened tail of the muskrat and the broad horizontally flattened tail of the beaver are useful as rudders. Perhaps the oddest of all is the naked prehensile tail of the opossum, which coils about branches or other support and thus is a safeguard against a possible fall, and even permits the animal to hang suspended by it alone.

STRANGE ADAPTATIONS TO MEET CONDITIONS OF ENVIRONMENT AND COMPETITION

In such ways, by thousands of adaptations and modifications of the typical four-footed mammal, are they fitted to their varied modes of life, each so far as possible in some special place of its own.

The effect of the pressure of environment and competition upon the various species of mammals in any region could not be better shown than by the kangaroos of Australia. That continent is occupied by many species of these peculiar mammals, some of which inhabit the open plains like our jack-rabbits in the West; others have learned to climb and live arboreal lives in the tree-tops; and still other members of this group have become burrowers and live in dens underground like some of our native rats and mice.

From the instances mentioned above it is evident that the mammalian organism is very plastic and has been molded

by the environment to which it has been subjected during the ages. The larger effects evidenced by profound modifications in the anatomy are the result of continued pressure extending far back in time. The far more numerous, modern, and superficial changes known to naturalists as geographic variations are everywhere in evidence.

By the collection of great series of specimens in North America and elsewhere in the world it has been proved that it is common for a single species of mammal to occupy a great area, including such diverse climatic conditions as humid forested districts near the sea-level, sections of arid desert plains in the interior, and high rugged mountain slopes. In each area of differing conditions it is ordinarily found that representatives of a species, under certain conditions, vary from those in other areas mainly in shades of color and in proportions.

GEOGRAPHY AND COLOR

In arid areas the colors are usually distinctly paler and grayer, in the humid districts they are darker and browner. Other conditions also effect these changes among members of the same species, as is shown in some of the most arid and desert plains of the southwestern United States, where mammals living among dark-colored lava beds are darker than those found, sometimes within a few rods, on paler adjoining soil. Complete isolation under the same climatic and other conditions sometimes produces marked changes, as is well illustrated by the difference between the Abert and Kaibab squirrels on the two sides of the Grand Canyon in Arizona (see page 448).

The different forms of a species occupying areas under varying conditions are commonly termed geographic races. They grade imperceptibly into one another along the border between their ranges, step by step with the gradations of the climatic and other conditions which have produced their differences.

ANIMAL CHEMISTS CHANGE STARCH INTO WATER

One of the most striking modifications of mammalian economy by environment is that shown in many small mammals of our southwestern desert region and adjacent parts of Mexico, in which such species as the kangaroo-rats, pocket-mice, prairie-dogs, and others are able to exist under the most arid conditions without drinking. The liquid necessary for supplying their bodily needs is obtained through chemical action in their digestive tracts, whereby some of the starchy parts of their food are changed into water.

Over considerable areas in the waterless deserts on the peninsula of Lower California periods of from three to five years sometimes pass without a drop of rain falling. In these areas the small desert mammals named above, as well as wood-rats, white-footed mice, cottontails, and jack-rabbits, are numerous and successfully pass these dry periods without inconvenience. The absolute independence of water of these animals has been demonstrated in southern California in the case of pocket-mice kept for months in captivity in a box and fed solely upon thoroughly dried seeds without their showing the slightest sign of discomfort.

Our small mammals may be roughly classified by their food habits into three main groups: Rodents, or gnawing animals; carnivores, or flesh eaters, and insectivores, or insect eaters.

GNAWERS MOST NUMEROUS OF MAMMALS

The rodents vastly outnumber all other mammals and are typified by the squirrels, rats, and mice; their food is mainly vegetable matter, but many of them eat insects and meat whenever available. The carnivores, including such species as the weasel, mink, and marten, are mainly flesh eaters, preying largely upon rodents, but they also eat insects and fruits of many kinds. The insectivores include the moles and shrews, which, with all the bats found within our limits, are almost exclusively eaters of worms and insects.

While rodents primarily feed on vegetable matter, it is surprising to note the large number of species among them which commonly feed on insects and have strong carnivorous propensities. This is not so much the case with such larger rodents as the beaver, porcupine, and woodchuck, but most of the smaller kinds,

Photograph by Howard Taylor Middleton

A MILLENNIAL SCENE: A RABBIT-HOUND AND A YOUNG RABBIT ENJOYING EACH OTHER'S SOCIETY

Here the camera records a friendship almost as remarkable as that which is to mark the association of the lion and the lamb in the final days of the world's history

from squirrels to mice, have been found to be confirmed flesh eaters.

The destruction of the eggs and young of birds, both on the ground and in the trees, by these animals must have a far-reaching effect in reducing the number of insectivorous and other small birds. Some small rodents, as the grasshopper-mice, subsist mainly upon insects and flesh.

The naturalist who sets traps for small rodents in field or forest is constantly annoyed by finding trapped animals partly devoured by their fellows. When mice or rats are confined together in cages and provided with an abundance of vegetable food, it is a common experience to find that the stronger kill and eat the weaker ones, until in a short time only a single survivor remains. These cannibalistic traits are strongly developed in the common house rat, which is notorious for its savagery toward others of its kind.

CASES OF CONCENTRATED FEROCITY

To a certain extent the ferocity of mammals appears to increase in proportion to a decrease in their size. The smaller members of the weasel family—the weasels—are relatively far more active and bloodthirsty than the minks, martens, and other larger members of the group.

If the common weasel should be increased to the bulk of a mountain-lion and retain its nature and physical prowess, it would be many times more dangerous than any existing carnivore and the devastations it would commit would be appalling. Even the tiny insect-eating shrews are endowed with a fierce and aggressive spirit scarcely equaled among larger animals.

Rodents and insectivorous mammals are without effective weapons of offense or defense against the birds and beasts

Photograph by Howard Taylor Middleton

A WEASEL AT BAY ON A TREE-TRUNK

Wolves, coyotes, and foxes are the natural enemies of this ferocious little creature. In spite of its diminutive size, it is a foe to be respected, for its attack is always aimed at a vital point—commonly the brain, the back of the neck, or the jugular vein of its adversary.

of prey which beset them. Many, however, are surprisingly courageous when brought to bay, and, using their front teeth, will fight to the death with vigor and spirit. This is especially notable of the muskrats and their cousins, the field-mice. Carnivores, both great and small, have teeth and claws with which to defend themselves against attack.

WHY THE SKUNK NEVER HURRIES

In addition, skunks have an even more potent weapon in the secretion of a vile-smelling liquid which is sprayed on a dangerous enemy. So confident are skunks in the efficacy of this weapon that they are extremely calm and unhurried in their manners and take little trouble to avoid an encounter with man or beast. Their odorous weapon is not used among themselves and appears to be held for service against more dangerous enemies.

Scent glands are common among rodents, carnivores, and insectivores, but are ordinarily used for purposes of communication with others of their kind, sometimes to attract the opposite sex and sometimes merely to give notice of their presence in a locality.

The hard school of experience holding through the ages has taught many of our rodents the necessity of lying up stores of food to meet periods of scarcity. Many species store food in a desultory way whenever a surplus is available, but when harvest time comes, at the close of summer, the work is taken up as a serious occupation during many busy hours each day or night by the species living where the severe northern winters make the stores a necessity.

The storage instinct is possessed as well by many of the southern desert species, where climatic conditions permit activity throughout the year. In such regions the supplies serve during storms and in periods of drought, when the yield of plant food is limited.

Photograph by Howard Taylor Middleton

ARMED NEUTRALITY: A DOG AND A SKUNK PREPARE FOR COMBAT

Once in a lifetime the photographer of wild life gets an opportunity such as is recorded here. Luck was with the camera man, but not with the terrier, as a moment after this picture was made the dog was a very nauseated and embarrassed animal, the skunk having employed its natural weapon with overpowering odoriferous effect.

GOOD HOUSEKEEPING IN RODENT LAND

One can but marvel at the wise prescience with which northern rodents gather their winter stores and hide them away safe from the weather in secret places in hollow trees, old logs, crevices among the rocks, or in neat storage chambers dug for the purpose adjoining underground burrows. The size of the stores and the tireless industry of these little husbandmen in gathering them might well serve as examples worthy of emulation by some of their human neighbors. The seeds gathered are freed from chaff, the grasses and herbs are dried as "hay," and roots are carefully cleaned before being stored.

The storing habit appears to be nearly always for purely individual benefit. The food is usually stored in bulk, but squirrels and chipmunks often bury here and there single nuts, which they are able to recover long afterward through their extraordinary powers of smell.

Stores are laid by for a single season, and a single failure of a nut or seed crop will cause the starvation of many small animals, and the failure of the crops for two or more seasons is so disastrous that the rodents may nearly or quite all die of famine over great areas. The reverse of this occurs during successive years of bountiful nut and seed crops.

An abundant food supply appears to be a powerful stimulant to the fecundity of mammals, and the number of young at a birth, as well as the number of litters born during a season, are greatly increased by it, until their haunts fairly swarm with them.

THE EBB AND FLOW OF ANTAGONISTIC SPECIES

With this stimulated increase of rodent life goes a related increase in the number of birds and mammals which prey upon them. The close relationship between the numbers of rodents and of the carnivores which prey upon them is shown by the records of the Hudson Bay Company, in which with the increase or decrease in the abundance of varying-hare skins secured by the fur traders goes a corresponding increase or decrease in the number of lynx skins taken.

After rodents become enormously

Photograph by Howard Taylor Middleton

IT IS NOT VANITY WHICH PROMPTS THIS MOUSE TO TAKE ITS OWN PICTURE

The bait is a grain of corn attached to one end of a thread; the other end operates the camera shutter; but the pose is almost "studied"

abundant, if food becomes scarce they sometimes make extended migrations, during which vast numbers swarm across the country, like the lemmings of the North or the gray squirrels during their historic migrations of early days in the eastern United States. At such times vast numbers of the wandering hordes perish; epidemic disease also plays its part in reducing their numbers. Nature thus is self-limiting in restraining the permanent increase of any species beyond the numbers needed to preserve its balance.

The advent of man in new regions with his clearing of forests, cultivation of the soil, and destruction of animal life for food or other purposes, quickly upsets the balance of nature, and some species are much reduced in numbers or disappear, while others, especially among the smaller kinds of mammals, may greatly benefit through added food supplies, and then increase until they become a pest, to be destroyed by the farmer as a measure of self-protection.

ANIMALS THAT SEEK SAFETY IN DARKNESS

For some reason, perhaps owing to their small size and defenselessness against birds and beasts of prey, the great majority of small mammals, including hundreds of species and untold millions of individuals, are nocturnal or live such obscure and hidden lives they are unknown except to the comparatively few people who go much afield, with all their powers of observation alert by day and by night. Many of the mainly nocturnal species pursue minor activities by day, where shelter of one kind or another gives them a reasonable feeling of security.

Under the revealing light of day most small mammals, especially the rodents, are extremely watchful and timid, leading lives filled with alarms which commonly end in tragic deaths. By night

Photograph by Howard Taylor Middleton

A NEST OF YOUNG WHITE-FOOTED MICE

One form of this small animal has been found living at an elevation of from 15,000 to 16,000 feet on Mt. Orizaba, Mexico, the highest record of any North American mammal

they appear to have far greater confidence; yet this also is a time of imminent danger from the owls and many beasts of prey then prowling about.

That the small rodents have good cause for their timorous ways is plain when we consider the array of enemies which encompass them, including owls, herons, gulls, bears, foxes, bobcats, weasels and their cousins, with snakes, and on occasion fishes, which take endless toll from their numbers. Fortunately for them, these small folk live wholly in the present and quickly forget the shadow of death cast by the passage of a hawk or the skulking form of a four-footed enemy.

COUNTLESS BEASTS THAT ROAM THE NIGHT

By day the squirrels, chipmunks, woodchucks, and spermophiles are abroad and unite with the birds to lend an air of pleasant animation to forest and plain. With the falling shades of night, near the abodes of mankind as well as in the remote wilderness, everywhere a countless multitude of small beasts come forth and form a little, bright-eyed furry world, clad in delicate shades of gray and brown and characterized by remarkable grace and agility.

These small folk of the night swarm out from snug nests hidden in burrows in the earth, in crevices among the rocks, in hollow trees, under logs or other cover, and even from the shelter afforded by buildings. In number and variety of forms they far exceed anything seen by day. The air is filled with the flitting forms of bats, while among the trees or on the ground, varying with the locality, are multitudes of rabbits, flying-squirrels, rats and mice of many kinds, lemmings, pocket-mice, kangaroo-rats, pocket-gophers, shrews, and even moles.

This abundance of night life brings forth the prowling powers of darkness in the form of velvet-winged owls, weasels, skunks, minks, martens, and other carnivores, which by scent and by keen vision find abundant harvest. The small carnivores, in turn, are subject to the preda-

Photograph by George Shiras, 3rd

A MINK TAKING ITS OWN PICTURE BY FLASHLIGHT

This is one of many remarkable nature studies which have been made possible by Dr. George Shiras 3rd's invention and development of animal flashlight photography, with the animals themselves as the photographers. The naturalist may have to spend hours, sometimes days, waiting in swamp or desert to study his quarry, but by means of flashlight photographs the inhabitants of the wild are revealed in their native haunts to all who read a story told in pictures. Dr. Shiras's notable contributions to this magazine have always won hearty appreciation from members of the National Geographic Society.

tory law of might and are at times hunted by the larger carnivores, as the great-horned owls, the wolves, foxes, fishers, bobcats, and mountain-lions.

To most people the majority of small rodents are classed as "rats" or "mice" and are viewed with the prejudice born of long familiarity with those omnipresent pests, the house rats and mice. The small beasts of field and forest are commonly of remotest kinship to these repulsive household parasites and are of entirely different lineage, having nothing in common but their size.

ANIMAL INTELLIGENCE AKIN TO MAN'S

When viewed with unbiased attention, these little animals of the wilds are certain to charm the observer either by their beauty and grace or by their varied and interesting habits. No one can long study mammals, large or small, without observing many traits of intelligence so akin to his own that they awaken feelings of friendly fellowship.

The modes of life of small mammals are much more varied than those of the larger species. At times radical differences in habits may be noted among different individuals of the same species, as instanced by the wood-rats of Santa Margarita Island, some of which live in burrows dug by themselves in the ground and others in nests built of sticks in the tops of mangroves rising amid the waters of a lagoon.

An even more extraordinary variation is shown among the heavy-bodied meadow-mice of the genus *Phenacomys*, most of which live in underground burrows; but one member of the group in Oregon builds its nests in the tops of tall

conifers, sometimes at an altitude of 80 feet, and rarely or never descends to the ground.

PEEPS INTO FUR-FOLK HOMES

The homes of small mammals vary greatly. The species living in underground burrows usually excavate an oval chamber which is filled with fine vegetable material to form a snug retreat. The muskrat places a conical lodge on the border of a marshy stream or lake. The wood-rat lives in an underground burrow, in a nest of sticks and trash heaped above the ground or in a stick nest placed among the branches of low trees. Harvest mice build a little hollow ball of grass blades, lined with finer material, among the branches of bushes several feet above the ground. White-footed mice may lodge in a knot-hole 50 feet or more above ground in the trunk of a tree.

As a rule, small mammals are of inconspicuous colors which harmonize so well with their surroundings that when not in motion, especially if lying close to the ground, they are difficult to distinguish. Exceptions to this rule are obvious in the case of jack-rabbits when standing on bare plains, or other mammals which are apart from the usual partly concealing growth of vegetation or other surroundings.

In contrast to the protective coloration are certain markings, like the cottony white underside of the tail of the cottontail rabbit, which renders the flight of this animal conspicuous in the gloomiest shades of the forest, or even on the approach of night, when it is impossible to distinguish the animal itself. The white underside of the tail of the antelope chipmunk is another well-defined instance of this kind.

NEW COATS FOR BOREAS' COURT

The most marked of all examples of "directive" coloration among the small mammals appears to be that of certain white-sided jack-rabbits, in which the white areas on the sides and rump are drawn up and down as the animal runs across the plains, giving a flashing effect, which attracts attention to them exactly as does the white rump-patch of the antelope.

In the northern part of the continent, where snow lies for many months, several species of hares are dusky or buffy gray in summer and change to a pure white coat in winter. This change is of enormous protective value to these animals. In Greenland, where the summer is short and snow exists throughout the year, the highest northern representative of the hares remains permanently white, while near the southern border of snow in the United States the varying hares and white-tailed jack-rabbits, which become pure white in the northern parts of their range, make only a partial change.

Weasels are the only carnivores which change from the brown of summer to a white winter coat. Owing to their small size and the need for activity in the snowy northern regions, where they would be peculiarly susceptible to danger from birds of prey and larger predatory animals, their protective white coats serve them well.

It was formerly considered that the change of mammals from the brown of summer to the white winter coat in the fall, and from the white to the brown in spring, was due to a change in the color of the hairs, but it is now known that it is entirely due to molt. The time of these changes depends on the season, and this varies several weeks, according to whether the fall or spring is early or late.

The general shades of mammals are of delicate tints, and the spots, stripes, and other markings, as in the case of chipmunks and the little spotted skunk, are often of great beauty.

ANIMALS THAT HAVE TO SING

Small mammals vary greatly in their vocal powers, but the changes in intonation and character of the notes and calls indicate plainly that they are used to convey a variety of meanings.

Some are practically voiceless, as in the case of rabbits and hares, except when in an extremity of fear they utter loud shrieks of terror. Squirrels, prairie-dogs, and some other small mammals bark and chatter, while mice and bats have a variety of curious squeaking notes. Marmots and ground-squirrels have chattering notes and sharp, whistling calls.

In addition, some of the squirrels and

many mice are known to have continuous series of notes which are as evidently songs as the utterances of birds. Some of these notes, as in the case of singing mice, have a remarkably musical character, similar to the warblings of canaries. Various unrelated species of mice have been observed singing, and a closer study of the life habits of these small animals may develop the fact that all are songsters to some degree.

House rats and mice have, undoubtedly, been parasitic about the haunts of man from early times. From Asia they have accompanied him through his advance in civilization. With the growth of commerce they have traveled around the world, becoming transplanted to all lands and thriving in all climates. In various parts of America they have not only become pests about human habitations, but where climatic conditions were favorable have reverted to the wild state and are competing with the native species in the fields.

Of all the small mammals none have become modified to such an extent as the bats. As a group these mammals are of world-wide distribution except in the inhospitable polar regions. They are true mammals and present an extraordinary variation in size, from tiny little creatures, almost as small and fragile as butterflies, to the huge fruit-bats, with a spread of wings like that of a wild goose.

BATS WITH BULLDOG FACES

The heads of bats are strangely sculptured, some being smoothly contoured and shaped like those of little foxes; others appear like miniature bulldogs; and still others have curious cartilaginous nose-leaves upright on the muzzle. Some have the entire face molded into a hideous mask repulsive to look upon.

Their habits are equally varied to meet special conditions: Some are eaters of fruit alone; others feed solely upon insects, while others bite other mammals, including man, for the purpose of drinking the oozing blood, upon which they subsist. All are nocturnal, but some appear late in the afternoon, before the sun sets; most species, however, wait until the shades of night have covered the earth.

Throughout the world the majority of the species of bats feed upon insects, but there are many fruit-eaters. The teeming insects and plant life of the tropics afford a never-failing food supply, and the center of abundance of these animals is found there. In some localities between twenty and thirty kinds of bats exist, with such vast numbers of individuals that the bat population far outnumbers all other kinds of mammals combined.

ANIMALS THAT PUT THEMSELVES IN COLD STORAGE

In the northern parts of the Old and New Worlds many mammals, including bears, marmots, prairie-dogs, ground-squirrels, and jumping mice, pass a large part of the winter months in a lethargic sleep called hibernation. While hibernating these animals have extremely slow and slight heart action and their bodily temperature falls far below the normal of their active periods. During the most profound hibernation an animal may be awakened if brought into a warm temperature, but when again put into the cold at once returns to sleep.

Preparatory to this sleep, during the summer and in the autumn, the hibernating mammals become exceedingly fat.

It has long been generally accepted that the fat thus accumulated was for the purpose of being gradually absorbed to nourish the animals during their long fast. As a matter of fact, during this period the bodily functions appear to be practically suspended and the animals may be said to be in cold storage. This is evident from the fact that observations have been made of ground-squirrels, and even bears, emerging in spring, after their long winter sleep, practically as fat as when they retired in fall. Hibernating animals become extremely active as soon as they come out in spring and quickly lose the fat which should be of special service to them, owing to the temporary shortage of food they experience at this season.

Most hibernating species do not retire for the winter until cold weather is at hand, in September or October, at times remaining out until after the first snow has fallen. The animals which retire

latest, like chipmunks and prairie-dogs, sometimes appear temporarily during certain warm periods in winter.

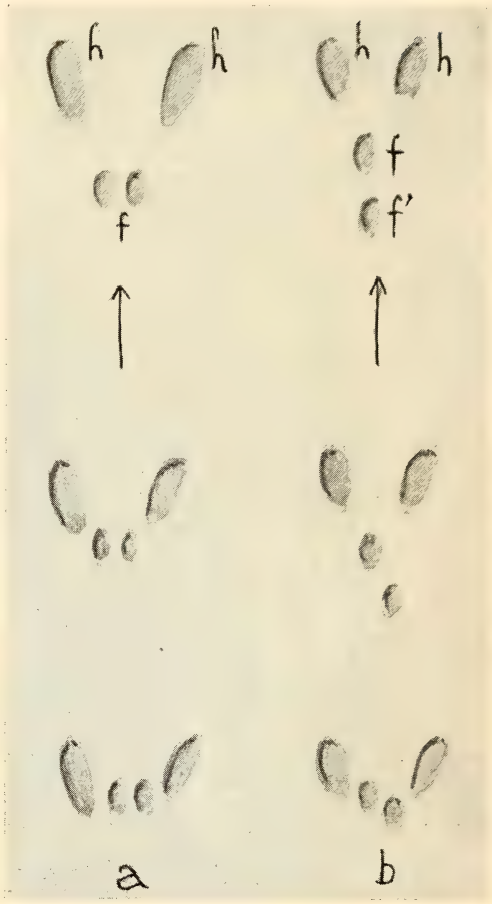
Recent observations have established the fact that the adults of both sexes of the Richardson ground-squirrel living in the Northwestern States and adjacent parts of Canada become excessively fat by the first of July, and before the first of August practically disappear for the season, not appearing again until they emerge the following March or April. The retirement of these squirrels for a part of the summer is a case of imperfect estivation, as it is termed, followed by complete hibernation. The young of the year enter hibernation at a considerably later date.

DEFENSIVE AND OFFENSIVE ANIMAL ALLIANCES

A great number of both large and small mammals live solitary lives except for brief periods during the mating season or the association of the young with the mother. Some species, however, like the wolves and coyotes, may mate permanently and show great mutual affection and constancy. Many species have well-developed social instincts, which appear in some cases to combine two purposes, self-defense and the desire for companionship.

Herds of large herbivorous mammals, such as musk-oxen and buffalo, frequently present a solid array of bristling horns to the attacking wolves, and thus protect the weaker members of the herd and give an example of the usefulness to them of the social instinct. Wolves and some other predatory animals hunt in couples or in packs and succeed in pulling down prey which singly they could not successfully attack.

Prairie-dogs living in colonies have the advantage of community intercourse as well as added safety through the chance that some member of the colony will espy an approaching enemy and by its warning cry allow a safe retreat. In other cases, such as the flying-squirrels, which gather in considerable numbers in hollow trees or other shelter, and the bats, which gather in caves, the congregation appears to be purely from a desire for close companionship.



FOOTPRINTS OF NATURE'S WILD FOLK

BY ERNEST THOMPSON SETON

In the drawings accompanying Mr. Nelson's article I usually give the track of a normal adult animal in about one inch of snow, that being ideal for tracking. Some of the smaller kinds are shown in fine dust. The trail goes up or across the page at the ordinary gait of the animal. The scale is indicated, but when possible the topmost set is given of life size. While there are endless variants in each kind, I aim to give the reader at least one typical set of each.

In all animals which bound, the hind feet track ahead of the front ones. This is very plainly seen in the rabbits. There are two arrangements of the fore feet when bounding: That of the rabbit (*b*), in which the fore feet are usually one behind the other, and that of the tree-squirrel (*a*), in which the fore feet are side by side. The latter arrangement is associated with power to climb a tree. The former means that the animal is purely terrestrial. These, however, are true only as generalizations. There are exceptions in all species. The ground-squirrels conform to the rabbit type. The tracks are, of course, ideal, giving far more detail than is usually to be seen.

THE ANTELOPE JACK RABBIT (Lepus alleni and its relatives)

(*For illustration, see page 404*)

The antelope, or Allen, jack rabbit is one of the most picturesque of American mammals. It is larger than the common western jack rabbit and is strongly characterized by enormous ears, long, slender legs, short tail, and contrasting colors. It is a member of the white-sided group of jack rabbits, which are distinguished by the extension of the white of the underparts well up on the sides of the body.

This group is represented in limited areas on our southern border by two species. One of these, the Gailliard jack rabbit (*Lepus gailliardi*), occurs on the grassy plains of extreme southwestern New Mexico and is succeeded by other white-sided species southward across the Mexican tableland and through interior Oaxaca to the Pacific coast, on the Isthmus of Tehuantepec. The other species, the antelope jack rabbit, occupies a considerable area in southwestern Arizona, and with its geographic races ranges southward through the coastal plains of Sonora and Sinaloa to northern Tepic.

All jack rabbits are more or less closely related to the Old World hares, the term "rabbit" having been so generally misapplied to them by the early settlers in the western United States that the name is now fixed by current usage. In Mexico and among the Mexicans of our southwestern border the proper distinction is made and the jack rabbit is termed *liebre,* or hare, and cottontail is called *conejo,* or rabbit.

The white-sided species are more widely differentiated from their Old World relatives than the other jack rabbits and are the southernmost representatives of the true hares in America, reaching their limit in the tropics a little beyond the Isthmus of Tehuantepec.

The extension of the white on the sides of these species assists in producing one of the most extraordinary examples of directive coloration known among mammals. I had the pleasure of discovering this one day in May, 1895, when hunting on horseback over the grassy plain bordering the Pacific coast of the Isthmus of Tehuantepec. As I rode slowly along, a big jack rabbit hopped deliberately from its form in the grass a few yards away, and by the contraction of a special set of muscles along the back drew the dark-colored dorsal area forward and together so that it formed only a narrow band on the middle of the back, with a corresponding extension of the white area on the rump and sides until, as the animal moved diagonally away, it looked almost entirely white.

At a distance of fifty or sixty yards it came to a stop, and expanded and contracted the dark dorsal area, thus producing a "flashing" effect with the changing area of white on the sides and rump. This solved the riddle of the mirror-like white flashes I had often seen as jack rabbits on the tableland had dashed away in the brilliant sunshine. The same habit of "flashing" the white was afterwards observed in the species of southwestern New Mexico and southwestern Arizona, demonstrating the appropriateness of the name, "antelope jack rabbit," given them by the ranchmen.

Formerly the antelope jack rabbit of Arizona was common on the plains about Tucson, where many were shot for rifle practice. They are now comparatively scarce in that district, and are never so excessively abundant as the common species of the West now and then becomes. They have an extraordinary appearance as, with their great ears erect, they stand poised on their long, thin legs. When alarmed, they leap away with amazing celerity in long, high bounds. They are usually much more shy and alert than the common jack rabbits and at times are far more difficult to stalk than antelope. A peculiarly appropriate setting to this remarkable species is found in the strange and wonderful growth of giant cactuses, yuccas, creosote bushes, fouquerias, palo verde, and other desert vegetation of the plains in Arizona and Sonora.

Like other hares, the antelope jack rabbits occupy forms under bushes or in the shelter of little patches of coarse vegetation. The only exception to this rule I have seen was west of the city of Guadalajara, on the Mexican tableland. There one summer day, in the midst of a lovely open valley covered with short, velvety green grass and dotted with scattered acacia bushes, a caracara eagle suddenly swooped down upon a young white-sided jack rabbit. In mortal terror the little beast dashed away at great speed, the caracara casting at it repeatedly from a height of fifteen or twenty feet and each time striking the ground just behind. The young animal ran not less than five hundred yards, straight for a little bush on a small bank, where it vanished as by magic.

The caracara was close behind and, alighting, ran round and round the trunk of the bush, craning its neck and apparently as surprised as myself at this sudden disappearance. Riding over to investigate, I found, partly concealed by coarse grass, the entrance of a burrow large enough to admit an adult jack rabbit. It extended almost horizontally into the bank for about eighteen inches, and then, turning abruptly to the left, ended in a rounded chamber some fifteen inches in diameter, in which the young jack rabbit lay snugly ensconced. It appeared altogether probable that this burrow had been made by the old jack rabbit as a shelter for her young, one of which in its extreme need had again sought asylum there.

White-sided jack rabbits are frequently found in pairs, occupying forms in close proximity to one another. More rarely several may be found in a small area. When driven from the forms, they often run in a wide circle, and in the course of half an hour or more may be detected returning slyly and watchfully from a direction nearly opposite to that in which they departed.

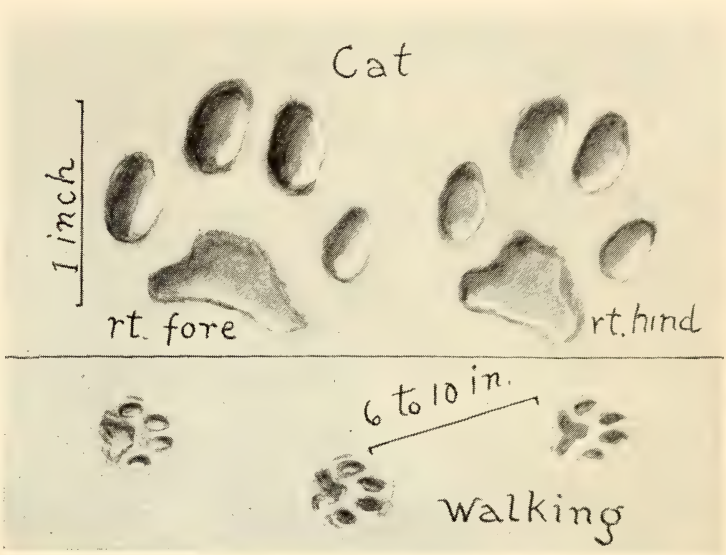
THE CALIFORNIA JACK RABBIT

(Lepus californicus and its subspecies)

(For illustration, see page 405)

The common hares, or gray-sided "jack rabbits" of the Western States, are among our best known and most interesting mammals. They are characterized by long, thin necks, long ears tipped with black, long legs, grayish sides differing but little from the color of the back, and a rather long tail, black on its upper side and dingy gray below.

They are abundant and generally distributed over a vast and mainly treeless area in middle North America extending from western Missouri and eastern Texas to the Pacific coast, and from the border of South Dakota and the Columbia River Valley of Washington south over the tableland of Mexico and throughout the peninsula of Lower California. Within this region they range from sea level up to an altitude of over 9,000 feet. In the North they experience severe winters with much snow, but never show any winter whitening of their furry coat, as do more northern hares.



A QUADRUPED WITH BIPED TRACK: THE COMMON CAT

The cat does not show its claws in the track. In walking, the hind foot is set exactly in the track of the front foot; this perfect register offers many advantages and makes for a silent tread. The track of the cat will probably be noticed more than that of any other animal, owing to the large numbers of them in every locality.

The gray-sided hares over all this extended range belong to a single species, typified by the California jack rabbit. The area thus occupied includes many different climatic and other physical conditions, from the sweeping grassy plains of Kansas to the juniper and pine dotted plateaus of the Rocky Mountain region, the foggy coast of California, the hot cactus-grown deserts of the Southwest, and the cool elevations of the Mexican tableland.

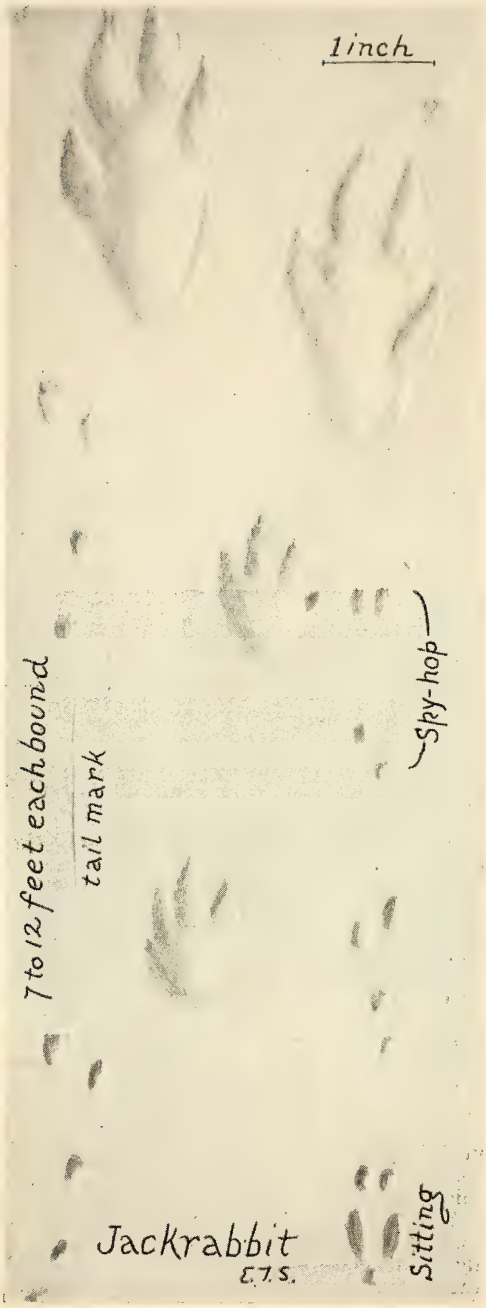
This varying environment has worked on the plastic organization of the species and modified it into a considerable number of well-marked geographic races which together make up the gray-sided group of jack rabbits, in contrast with the white-sided group already described. Some of the races are very dissimilar in color, but each merges imperceptibly into its neighboring races, and the group thus forms an unbroken chain of subspecies.

Like other hares, the jack rabbits are both diurnal and nocturnal in habits. They do not burrow, but make forms among dense growths of grass or weeds, or under bushes, where they lie hidden. It is a question whether they have more than one litter a season, although it is known that in some parts of their range young are born at all times throughout the spring and summer. From one to six are produced at a time, fully clothed in fur and with their eyes open. Within a few days they leave the "form" and run about like little furry balls. Even at this early period they are amazingly alert and skillful in evading capture by quickly doubling and zigzagging when pursued.

Throughout its range the gray-sided jack rabbit is preyed upon by a host of enemies, including wolves, coyotes, wildcats, eagles, and several species of hawks and owls. As a result it has become extremely cunning and watchful. It is a beautiful sight to observe the cautious grace with which one that suspects danger but thinks itself unobserved will quietly move out of its form, pause like a statue for a few seconds, then raise its body into a sitting posture and look keenly about, its great upstanding ears turning sensitively to one side and the other, delicately testing the air for sound waves, which may spell approaching peril.

If not alarmed it may then move slowly along by a series of easy little hops, occasionally varied by the single-footed gait of most other mammals. At such times the ears are often raised and lowered as though worked by some mechanism. If the rabbit becomes alarmed, however, it leaps away in quick, springy and graceful bounds, now and then making a high soaring leap as if to command a better view.

These occasional high leaps mark the first stages of alarm. In greater stress, when pursued by a coyote or other swift-footed enemy, the jack rabbit indulges in no such showy performances, but gets down to serious work, and



THE TRACKS OF THE JACK RABBIT

The tracks of the western jack rabbit resemble those of the cottontail (see page 390), but the feet are seldom paired; a typical set is seen in the lower left-hand corner. The bounds cover 10, 12, or even 15 feet each. The tail is held down, so that it leaves a mark in the snow between each bound. Sometimes the animal makes a spy-hop—that is, hops up high to look around. This is seen in the track.

developing marvelous action in a continuous series of rapid, low stretching leaps, with ears lying flat along the shoulders, it skims over the ground almost as swiftly as a bird. Coursing jack rabbits with greyhounds was for many years a favorite sport in different parts of the West. No other dog has much chance for success in the open pursuit of these animals.

Ordinarily jack rabbits are mute, but when wounded and caught they not infrequently utter a series of long-drawn wailing shrieks which are movingly expressive of terror and pain.

Since the settlement of the Western States numberless predatory animals have been killed and at the same time the cultivation of the soil has produced a dependable increase in the food supply. These changes have resulted in the sporadic increase of jack rabbits in many parts of their range, from Texas to Oregon, until at times they have become a serious menace to agriculture.

During such periods of abundance they invade fields and devastate grain, forage crops, vineyards, and young orchards. In places they sometimes actually destroy entire crops and force settlers to abandon their locations. In winter they swarm about haystacks and destroy many tons of hay. Depredations of this character were committed by them on a considerable scale during 1916 in parts of Oregon, Idaho, and Utah.

During the early development of the San Joaquin Valley, California, jack rabbits became such an intolerable pest that great community drives were organized. Large woven wire corrals with wing fences leading away several miles from the entrance were built on the open plains. The occasions of the drives were made public holidays through all the surrounding region, and people gathered sometimes to the number of from 5,000 to 8,000. A great line of beaters was formed, miles in length, and the jack rabbits were driven between wing fences into corrals. Four such drives in Fresno County in the spring of 1892 resulted in the destruction of 40,000 jack rabbits, one drive netting more than 20,000 animals.

At this time the level floor of the San Joaquin Valley was crossed by numberless well-worn rabbit trails six or eight inches broad and one or two inches deep, extending in long straight lines sometimes for miles. On approaching a patch of large weeds one often saw twenty or thirty jack rabbits dash out and, after hopping away a short distance, sit with upstanding ears to look curiously at the intruder.

It is a general rule that when any species of animal becomes extremely numerous it loses its ordinary wariness and, conversely, when its numbers are materially reduced its wariness is greatly increased. The periods of abundance of jack rabbits usually extend through several years until, at the height of their increase, a contagious malady suddenly sweeps them away almost to the point of extinction, as in the case of the varying hare. A period of years follows during which their numbers are slowly recovered.

Jack rabbits are specially adapted for life on great plains, where speed and the ability to subsist on almost any form of vegetation are prime qualities. They are as grotesquely characteristic of the Western States as the kangaroos were of Australia, and have entered largely into the literature of the region they occupy.

THE VARYING HARES (Lepus americanus and its relatives)

(*For illustration, see page 405*)

The varying hares, white rabbits, or snowshoe rabbits, as they are known, form a small group of closely related species and geographic races of hares peculiar to northern North America. They sometimes attain a weight of five pounds and are about half the size of the arctic hares, which they resemble in form, except that they are more heavily built and have proportionately shorter legs and larger hind feet.

With a single exception they become white in winter and change to dusky or brownish in summer. The molt from the brown summer coat to the white winter one occurs with the arrival of winter snows, the exact time varying according to the season, the reverse change in spring being governed in a similar way by the disappearance of the snow. In the southern part of their range the change to the white winter coat is less complete than in the North. There has been much controversy over the manner of this change in color, some maintaining that on the approach of winter the hairs turn white with the first snow. It has been definitely proved, however, that both seasonal changes are due to molt.

The Washington hare (*Lepus washingtoni*), which remains brown throughout the year, is the exception to the rule of white winter coats in this group of hares. It lives in the cool, dense forests of the humid coast belt of Washington and adjacent part of British Columbia, where the snowfall does not affect its pelage.

In winter the large hind feet of the varying hares and their long, spreading toes are entirely covered with a heavy coat of hair, forming broad snowshoe-like pads, which enable their possessors to move about freely over the soft snow, a peculiarity that has given rise to one of the names in common use.

In cool, forested regions varying hares range from Maine and extreme eastern Canada, including Newfoundland, to the Pacific coast, and from the stunted bushes bordering the northern limit of trees south to the northern border of the United States and beyond, following the higher Alleghenies to West Virginia, the Rocky Mountains to New Mexico, and well down the Sierra Nevada in California.

As in the case of other species, these hares make "forms" in which they lie by day, for they are mainly nocturnal in habits. The mating season occurs in early spring, when the males become very restless, several sometimes congregating in the same vicinity and occasionally fighting and chasing one another about. At this time, as well as at other seasons, snowshoe rabbits have a habit of thumping rapidly on the ground, making a dull sound audible for some distance. This is probably done with the hind feet, as is known to be the case with the European rabbit.

The thumping is apparently a signal and may be a part of the mating display, but is also used for warning purposes. Hunters in northern Canada call these rabbits by making a harsh squeaking noise with their lips. Sometimes they become so eager and excited on hearing this call that with odd little grunting sounds they come bounding close up to the hunter.

The young, varying from two to seven, are born in nests made of dry leaves, grasses, and other suitable vegetation, warmly lined with hair from the mother's body, and usually hidden under brush or in dense vegetation. The young, which have their eyes open and are fully furred at birth, within a few days leave the nest and move freely about. Although the mother snowshoe rabbit will defend her young at first even at the risk of her life, when they are half grown she leaves them to shift for themselves. Young hares of various ages when caught often utter shrill squealing cries of fright and the older animals when wounded and caught sometimes do the same.

Perhaps through living so constantly in low ground, among swamps and along streams, varying hares become less averse to entering water than most of their kind. In the delta of the Yukon River I saw many places where they had crossed small streams in spring, their wet tracks entering and leaving the water, thus furnishing unmistakable evidence. Curiously enough, when caught by a flood they will take refuge on stumps or other support and often remain to starve rather than swim ashore.

In summer, owing to their nocturnal habits and the dense thickets they inhabit, varying hares are rarely seen unless they are unusually plentiful. In winter their presence is known by their conspicuous tracks, leading in every direction through their haunts. A single animal will in one night so thoroughly track the snow in a patch of woods it gives the impression that several must have been there.

In river bottoms, among densely wooded swamps, these rabbits frequently make definite beaten runways in the snow; runways are also made through thickets in their summer haunts. This habit renders it easy to snare them, and enormous numbers are thus captured every winter.

They feed on a variety of small herbage in summer and in winter depend on buds, twigs, and the bark of shrubs and small trees. They are specially fond of willows, and their winter distribution in many districts is governed by the abundance of willow thickets.

Varying hares are one of the most important mammals of the northern fur country. They are generally distributed and exist in such num-

FOOTPRINTS OF THE VARYING HARE, OR SNOWSHOE RABBIT

The great size of the feet from which the creature is named is a strong feature of the track, distinguishing it from that of the cottontail and others (see pages 387 and 405)

bers that they are an important source of food supply both to the Indians and to such predatory birds and mammals as the great horned and snowy owls, the goshawk, gyrfalcon, lynx, fox, ermine, fisher, and others. The skins are also used by the Indians for robes.

Under favorable conditions they steadily increase until they become enormously plentiful over great areas. After this swarming abundance continues for several seasons it reaches a maximum, and then, as in the case of many other mammals when similarly overabundant, a mysterious malady suddenly attacks and sweeps them off, until within a year or two they become rare over the entire area. The people of the fur country believe these changes in

numbers run in cycles of about seven years each.

As the hares increase in numbers some of the birds and mammals which prey upon them increase proportionately. This is specially marked with the big northern lynxes. The skins of varying hares are gathered and sent to the London fur market with other furs, including those of lynxes. In the records of sales of the Hudson's Bay Company there are direct increases of the numbers of Canada lynx skins sold corresponding with the increases in the sales of varying hare skins. As the number of hare skins abruptly decreases following the outbreak of epidemics among them, there are correspondingly abrupt decreases in the numbers of lynx skins sold.

This correlation is shown in the records extending back many years and illustrates the interdependence in nature between the various forms of animal life. The far-reaching tragic effect of the sudden disappearance of the snowshoe rabbits is not confined to the wild habitants of the forest, as it has not infrequently brought starvation and death into many lonely Indian lodges in the great northern wilderness.

THE ARCTIC HARE (Lepus arcticus and its relatives)

(*For illustration, see page 408*)

Many parts of the northernmost circumpolar lands are occupied by large hares, which attain a weight of more than ten pounds. They are about the size of large jack rabbits, but are more heavily proportioned, with much shorter ears and shorter, stronger legs. There are several species and geographic races of these animals, all of which are snowy white in winter except for a small black tip on each ear. In summer the southern arctic hares change to a nearly uniform dull iron gray or grayish brown. The northernmost animals of Ellesmere Land and north Greenland, where the summer is brief and severe arctic conditions prevail, retain their white coat throughout the year.

In keeping with the cold climate of their territory, the furry coat of the arctic hares is long and thick, especially in winter, when the ears, legs, and even the soles of the feet, as well as the body, are heavily furred. The coats of the hares of north Greenland and adjacent region are so heavy and fleecelike that during the spring molt they come off in felted patches as the new coat is assumed, giving the hares a curiously ragged appearance.

In the region between the areas in which the summer coat remains wholly white and where it is completely changed to grayish, there is a gradual transition, with the lessening severity of the climate, through every intermediate degree between the two. As in the case of the snowshoe rabbit, the large hind feet and long spreading toes of its big northern relative are so heavily covered with hair that they form broad fluffy pads, which enable the hares to travel lightly over the arctic snowfields.

The distribution of arctic hares is confined to the barrens or tundras beyond the limit of trees. They range practically to the land's end of northern Greenland and Ellesmere Land To the southward in North America they range down the coast of Labrador and across to Newfoundland, where they are limited to the open barrens. They also occur along the shores of Hudson Bay and follow the tundras bordering Bering Sea to the peninsula of Alaska.

In Ellesmere Land they are reported to be extraordinarily numerous at times in certain little valleys, and the fur traders on the coast south of the Yukon Delta informed me of similar gatherings in spring on gently sloping hillsides in that region. Photographs taken in Ellesmere Land show many of these hares scattered over a small area, each crouched in a compact form and all heading in the same direction to face the wind. Such gatherings, at least those in Alaska, occur during the mating period, after which the animals scatter over the area they occupy.

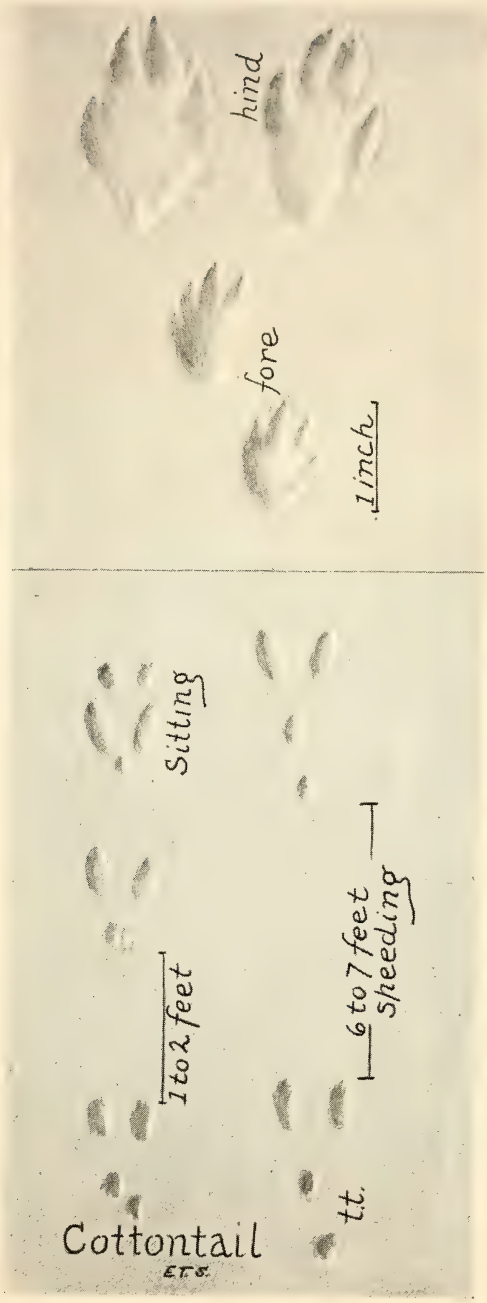
An account of the big northern hares would be incomplete without reference to the white-tailed jack rabbit, the largest of all American hares and a near relative of the arctic species. It attains a weight of twelve pounds or more and appears like a giant of its kind. It has longer legs than the arctic hare and a longer tail. In summer it is grayish or buffy, with a conspicuous pure white tail. Throughout most of its range in winter it becomes pure white except the black tips to the ears, but near the southern border the change to white is not so complete as in the North. The distribution of the white-tailed jack rabbit extends from Minnesota to the Cascade Mountains and from the Saskatchewan River, in Alberta, south to southern Colorado.

Arctic hares have from one to seven young in a litter each spring. Owing to the climatic conditions under which they exist, it is doubtful if more than a single litter is born each year.

The manner in which animal life adapts itself to its environment is beautifully illustrated by the arctic hares of north Greenland and Ellesmere Land. There the conditions are rigorously arctic and continuous winter night extends through a period of several months. In all this region the scanty and dwarfed vegetation is covered with snow and ice the larger part of the year. The hares living there are, with little question, a geographic race of those living farther south, but have developed into larger and stronger animals, with heavier fur, to meet the sterner conditions of life.

Their claws are much larger and heavier, so that they may dig the snow from the hidden herbage. Most marvelous of all, the anterior ends of both jaws are lengthened and the incisors set so that they project and meet at an acute angle, thus serving, tweezerlike, more readily to pick out the lowly vegetation imbedded in the snow.

In most parts of their range arctic hares are scarce and rarely encountered. Each winter during my residence on the coast of Bering



THE COTTONTAIL RABBIT'S TRACK

The large set of four tracks at the top gives the maximum possible of detail, which is very rarely seen. The lower figure at the right-hand corner is a typical track (*tt*). At the set marked "sitting" the tail mark is seen, and in this only are the fore-feet tracks ahead of the hind tracks. The cottontail has five toes on the front feet, but only four ever show in the track (see page 408).

Sea the Eskimos killed only a few individuals. They were shy and watchful and the hunters sometimes followed one on snowshoes all day over the tundra without securing it. In the high North they appear to be more numerous in places, judging from the number killed for food by members of polar expeditions. Their flesh is excellent, but a little dry. Their natural enemies include wolves, foxes, weasels, gyrfalcons, and snowy owls, all of which share their desolate haunts and join in destroying them.

The winter skins of arctic hares have a beautiful snowy white pelage, which make warm garments and sleeping robes for the North, but are too delicate to withstand much service.

THE COTTONTAIL RABBITS (Sylvilagus floridanus and its relatives)

(*For illustration, see page 408*)

North America has several species of hares, but no typical representative of the European rabbit. The American cottontails and their near relatives, the brush rabbits and others, combine characteristics of both the hares and rabbits, but are most like the rabbits, of which they appear to form aberrant groups.

The cottontails are distinctly smaller than most of the American hares and average from two to three pounds in weight. They are otherwise contrasted with the hares by their short ears, proportionately shorter and smaller legs and feet, and by the fluffy snow-white underside of the tail, which shows so conspicuously as they run that it has given them their distinctive name.

The American mammals to which the term "rabbit" may be properly applied include not only the cottontails, but numerous other species closely similar in form and general appearance, but lacking the cottony white tail. As a group, these rabbits have a far greater distribution in America than the hares. They range from the Atlantic coast to the Pacific and from the southern border of Canada south through Central and South America to Argentina. Their vertical distribution extends from sea level to above timberline, attaining an altitude of more than 14,000 feet on Mount Orizaba, Mexico.

In the United States cottontails are so numerous and generally distributed that they are well known to nearly every one. They inhabit all kinds of country, from the deciduous forests of the Eastern States to the grassy or brush-grown plains and pine-clad mountain slopes of the West and the sun-scorched deserts of the Southwest. As a result of this extended distribution and the variety of conditions in the areas occupied, these rabbits include numerous species and geographic races, which in some instances differ greatly in appearance.

Cottontails are especially common about the brushy borders of cultivated lands throughout the country, and in fertile brush-grown areas of foothills, valleys, and river bottoms of the

West. They are mainly nocturnal, and in areas where there is an abundance of natural cover in the way of brushy thickets and dense grass commonly make concealed "forms" in which they lie safely hidden.

In areas where shelter is represented by scattered bushes and a comparatively thin growth of other vegetation they generally occupy burrows in the ground. These may be holes deserted by badgers or prairie-dogs or dug by themselves under a rock or other object. Hollow logs or natural cavities and crevices among the rocks are also frequented. When pursued by dogs, hares as a rule rely solely on their speed for safety, while the cottontails take refuge in the first hole they can reach.

Everywhere in their territory, as the shades of night approach, the cottontails come forth from their hiding places and skip merrily about in open ground on the borders of thickets and similar shelter, where they search for the tender green vegetation on which they love to feed. After it becomes too dark to distinguish their forms, the white tail may be seen twinkling about in the dusk. During the night they are often revealed in country roads by the head lights of automobiles.

Several litters of from two to six young usually appear during the spring and summer. These are born blind and practically naked, their unclad helplessness strongly contrasting with the open-eyed, fully furred, and alert young of the hares at the same age. This is a conclusive indication of the close relationship between cottontails and European rabbits, the young of the latter being similarly, but even more, undeveloped at birth.

The young of the cottontails are born in nests made of dead grasses warmly lined with fur from the mother's body. If above ground the nest is placed in a little depression and so artfully concealed by a covering of dead grasses that it can be discovered only by accident. When caught, young cottontails utter little cries of alarm; the wounded adults sometimes shriek in terror.

From the early settlement of the United States to the present day cottontails have been so abundant that they have served as a valuable source of our game food supply. They are hunted with guns and with dogs, as well as being snared and trapped. Enormous numbers, running into the millions, are killed in this country yearly, but they are so prolific that they hold their own in a surprising degree.

Their abundance in many places, however, has made them a serious pest to agriculture. They eat growing alfalfa and other forage plants, many kinds of cultivated vegetables, young grape vines, and nursery stock and even kill orchard trees by gnawing the bark from the base of the trunks. As a result those who suffer from their depredations consider them pests to be destroyed, while others look upon them as desirable game animals to be protected by law.

As game animals the cottontails furnish some of the most delightful and interesting sport available to American hunters. The scurrying zigzag rush of a cottontail for the nearest shelter is so full of energetic motion that it always excites a pleasurable thrill in the observer, and even the keenest sportsman has so friendly a feeling for these little animals that the escape of one of them from an unsuccessful shot nearly always leaves a feeling of humorous amusement.

The cottontails have a secure place in American literature and folklore. Who has not read the wonder stories of the adventures of "Brer Rabbit" and ever after had a warmer feeling of fellowship for his kind? The presence of cottontails is a source of pleasure to children of all ages, and their disappearance from the wild life of a locality creates a more deeply felt blank than would the passing of many a nobler animal.

THE MARSH RABBIT (Sylvilagus palustris and its relatives)

(*For illustration, see page 409*)

The marsh rabbit, or "pontoon," as it is known in Georgia, is a distinctively American species allied to the cottontails, but distinguished from them by its more heavily proportioned body, smaller ears, shorter and slenderer legs and feet, and shorter, nearly unicolored tail. Its only close relative in the United States is the swamp rabbit, known in Alabama as the "cane-cutter."

These two species appear to be members of a Tropical American group of which other members are the wood rabbits of Mexico, Central and South America. The distribution of the group was probably at one time continuous, but a change to arid conditions in northeastern Mexico and Texas isolated the two species remaining in this country.

The distribution of the marsh rabbit is limited to the southeastern coastal States from Dismal Swamp, Virginia, to Mobile Bay, Alabama. It is common in suitable places in Florida. Its larger relative, the swamp rabbit, ranges west from this area to Texas and up the Mississippi Valley to Illinois and southeastern Kansas. Swamp rabbits are numerous in the low, wooded coastal region of Louisiana. They are larger and longer-legged than marsh rabbits and fleeter of foot.

Among all the rabbits of the world the marsh and swamp rabbits are the only species which have aquatic habits. Both live mainly in marshes, wooded swamps, and along the low wooded courses of streams. Other rabbits and hares are occasionally known to cross water by swimming, but the marsh and swamp rabbits live about the water and take to it with all the freedom of a muskrat or mink. The marsh rabbit appears to be the more aquatic of the two, as the swamp rabbit sometimes lives in the forest, farther back from the water.

The Tropical wood rabbits are habitants of the dense forests, where they are well hidden under the rank undergrowth. They are not known to enter the water, but, like their northern relatives, make runways through the dense

vegetation they frequent. The marsh rabbits live in cypress or other fresh-water swamps, heavily wooded bottoms, and fresh water, as well as brackish marshes. They feed on a variety of vegetation growing in such places and dig up such edible roots as the wild potato and amaryllis.

Both marsh and swamp rabbits have several litters of from two to six young each season, beginning in April. The young are born in large, well-made covered nests, which are built of rushes, grasses, and leaves and lined with hair from the parents. The nests, which have an entrance on one side, are usually located in the midst of dense growths of vegetation or on tussocks, in low, swampy places, and are sometimes surrounded by water. In the most frequented parts of marsh and swamp these rabbits make well-trodden trails through the dense vegetation.

When alarmed, marsh rabbits run for the nearest water, into which they plunge and swim quickly to the shelter of aquatic plants or other cover. When cut off from escape by water they try to avoid capture by doubling and turning, but are so short-legged that they are readily overtaken by a dog. The tracks of these rabbits in the mud differ from those of the cottontails in showing imprints of the spreading toes.

In South Carolina Bachman once found numerous marsh rabbits in the thickets about recently flooded rice fields and swamps. When he beat the bushes the rabbits plunged into the water and swam away so rapidly that some escaped from a Newfoundland dog which accompanied him. Several, apparently thinking themselves unnoticed, stopped and remained motionless about fifteen yards from the shore, with only their eyes and noses showing above water. Thus concealed in the muddy water, with ears laid flat on their necks, they were difficult to see. When touched with a stick they appeared unwilling to move until they saw that they were discovered, when they quickly swam away.

Later, when the water subsided to its regular channels, where it was about eight feet deep, many of the rabbits were seen swimming about, meeting and pursuing one another as if in sport. One which Bachman had in captivity during warm weather would lie for hours in a trough partly filled with water, with which the cage was furnished.

THE PIKA, OR CONY (Ochotona princeps and its relatives)

(*For illustration, see page 409*)

The pika, little chief hare, or cony, as it is variously named, is among the most attractive and interesting of our mountain animals. It is about the size and shape of a small guinea-pig, with a short, blunt head, broad, rounded ears, short legs, practically no tail, and a long, fluffy coat of fur. While most nearly related to the hares and rabbits, it has very different habits.

The pikas form a group comprising many species, much alike in general appearance and distributed among the high mountains, from the Urals of Russia through Asia and northern North America. In Asia they occur mainly in the mountains through the middle of the continent south to the Himalayas. In Pleistocene time they ranged across Europe to England. In North America they are limited to the western side of the continent, from the Mount McKinley region of Alaska down the Rocky Mountains to New Mexico and along the Cascades and Sierra Nevada to the Mount Whitney region, in California.

Giving to these North American animals the appellation "cony" is one of many instances in which the name of an Old World animal is brought to America to designate a totally unrelated species. Once fixed in current use, the misapplied term is certain to persist.

Pikas are among the few mammals which live permanently along the high crests of the mountains, mainly above timberline, but they also descend in rock slides among the upper spruces, firs, and pines. The altitude of their haunts varies with the latitude, being between 8,000 and 13,500 feet in the United States, but in Alaska much lower.

In these cool, alpine regions the little animals live wholly within the shelter of rock slides and among the crevices of shattered rock masses. Their distribution is unaccountably broken, and although abundant in many places, they are absent from many others equally suitable. Their homes are in the midst of the flower-bedecked glacial valleys and basins, the haunts of the big marmots and mountain sheep.

They are mainly diurnal in habits, and throughout the day may be heard their odd little barking, or bleating note, like the syllables "eh-eh" repeated at intervals in a nasal tone, resembling the sound made by squeezing a toy dog. Occasionally they may be heard barking at night, perhaps when disturbed by some prowling enemy. Their notes have a curiously ventriloquial quality, which renders it difficult to locate the animals uttering them.

Owing to their dull gray or brownish colors, the pikas blend with their background so completely that when quietly sitting on a rock they are extremely difficult to see. Even when running about at a little distance they are not easily noted. Their movements are quick and they scamper over the rough surface of a rock slide with surprising agility.

Little is known of their more intimate life history. Their young, three or four in number, are born usually during the first half of summer and are out foraging when less than half-grown.

Small, bright eyes and big, rounded ears give pikas an odd and attractive appearance, unlike that of any other mountain animal. They are extremely watchful and at the first alarm disappear in the shelter of their rocky fortresses. Their little bark, however, continues to come up from their hiding places with constant iteration. If the observer will sit quietly at some good vantage point his patience will eventually

be rewarded by the appearance of the pika on the top of a stone near the mouth of its retreat.

After a time, if everything is quiet, it resumes its scampering about over the rocks or may come to the border of the slide and make little excursions across the open ground after some of its forage plants. Skipping nimbly from the border of the slides to neighboring patches of vegetation, sometimes fifty or more feet away, the pika nips off the stems of short grasses or other plants and taking them up, like small bundles, crosswise in its mouth, runs back to add them to its "stacks." These sallies are quick little runs, made as though in fear of being long away from the safety of the rocks. Caution is needful, however, in a world where lurk such enemies as coyotes, lynxes, foxes, weasels, hawks, and owls.

During late summer the pikas have the extraordinary habit of gathering stores of small herbage in piles containing sometimes a bushel each, usually well sheltered in dry places under the rocks where they live. Pikas are active all winter, and these little stacks of well-cured hay, containing a great variety of small plants, serve them as food during the severe cold season, when at these high altitudes they are buried under many feet of snow.

In pleasant weather, near the end of summer, visitors to the mountains of Colorado, Glacier National Park, the high slopes of Mount Shasta, or of the Sierra Nevada may have the pleasure of watching the pikas hard at work doing their "haying." One of their "stacks" in the mountains of New Mexico contained thirty-four kinds of plants, including many flowers. No one who once becomes acquainted with these unique and gentle little animals will ever cease to remember them with friendly interest.

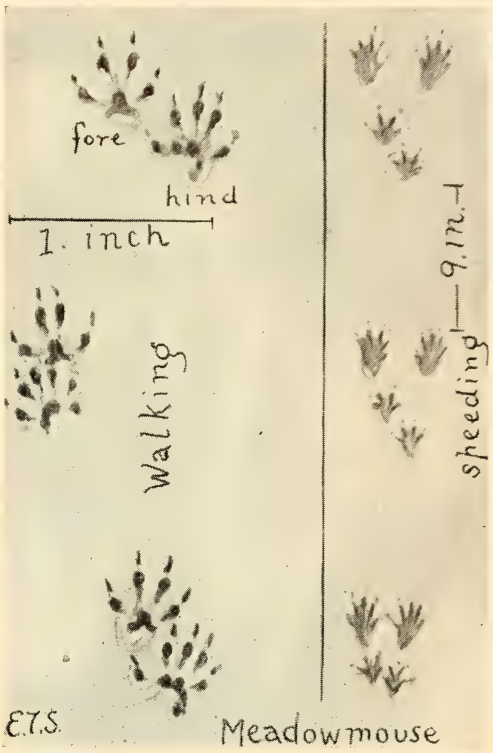
THE PORCUPINE (Erethizon dorsatum and its relatives)

(*For illustration, see page 412*)

The porcupine is one of the most grotesque of the smaller North American mammals. With a weight of from fifteen to twenty pounds, its heavy body is supported on short legs, the feet resting flat on the ground like those of the raccoon, instead of on the toes, as in most small animals.

Its strongest peculiarity is the specialized development of most of the fur into rigid, sharp-pointed spines or "quills" from half an inch to over three inches in length. That the spines represent the underfur of ordinary mammals is evident from the fact that they are overlaid by long, coarse guard hairs, sometimes several times their length.

The spiny armament usually lies flat on the body, but when the animal is excited or alarmed it may be raised, by special muscles on the underside of the skin, into a bristling array of barbed points. The spines are so slightly attached that when their points enter the skin of an enemy they at once become free at the base. The points firmly set in the skin



THE TRAIL OF A FIELD OR MEADOW MOUSE

When compared with that of the deermouse, one notes the absence of the tail mark and the rarity of the fore feet being paired (see pages 403 and 420).

of another animal, the spines can be withdrawn only with considerable effort, and if left will gradually work deeper and may traverse a considerable part of the victim's body before finally becoming encysted.

When assailed the porcupine turns down its head, arches its back, and, on firmly planted feet with all its spines erected into a bristling cover, awaits the enemy. The instant its body is touched the club-shaped tail, armed with a multitude of spines, is swung vigorously around and the animal so incautious as to receive the blow is pierced by a host of stinging darts which, freed from the porcupine, remain to torment the aggressor. This swift and effective sweep of the tail has probably given rise to the idea that the porcupine can "shoot" its quills when defending itself.

Despite its defensive powers, however, the porcupine is, on occasion, successfully attacked by various enemies, including the mountain lion, bobcat, fisher, and even the eagle and great horned owl. The fisher is said habitually to kill and feed upon them, and the encysted quills are commonly found under its skin.

The frightful effect of an ill-judged attack on a porcupine is shown by inexperienced dogs

after their first encounter with this strange beast. That such an attack is a dangerous venture, even by the craftiest and most powerful of its enemies, is well demonstrated by occasional fatalities among large carnivores which result from the great mass of spines imbedded in their heads and bodies.

The North American porcupine is a northern animal belonging mainly to coniferous forests, and ranges from sea level to timberline. It originally occupied nearly all the forested parts of the continent south to West Virginia, southern Illinois, the Davis Mountains of western Texas, and the southern end of the Sierra Nevada in California, but was absent from the Southeastern States and the lower Mississippi Valley.

While characteristically a woodland animal, at times it wanders from forest shelters and has been found prowling about above timberline on high mountains, and among alder thickets beyond the limit of trees in the far North. They are usually silent, but at times utter a curious squealing cry, and in addition have a variety of snuffing, growling, and chattering noises.

In the forests of tropical America, from Mexico to Brazil, other and shorter-quilled porcupines occur, characterized by smaller size and slenderer bodies with a long tail, the terminal half of which is naked and prehensile like that of an opossum. These animals inhabit forests where no conifers grow, and are much more arboreal in habits than their northern relatives. Still other and even more strikingly different porcupines occur in Europe, Asia, and Africa, some of the African animals having heavy spines more than twelve inches long.

All porcupines are true rodents, and the name hedgehog is erroneously used when applied to any of them. Hedgehogs are small Old World insect-eating mammals, which have their backs covered with porcupine-like spines, but are in no way related to the porcupines.

The American porcupines are mainly nocturnal, although they sometimes wander about by day. While largely arboreal in habits, they pass much of their time on the ground and commonly have their dens in caves at the bases of cliffs, under the shelter of large rocks, logs, piles of brush, or in hollows at the bases of trees. They are sluggish, stupid animals, with poor sight, and are unable to move rapidly, either in a tree or on the ground.

Although on the ground they are extremely deliberate, in the treetops they are even more sluggish and can be compared only with the sloth. In consequence they are practically helpless in the presence of an enemy except for the defense afforded by their spiny armor. That in most cases this is effective is evidenced by their continued presence throughout a large part of their original range where forests still exist.

Porcupines are solitary animals, totally devoid of any qualities of good fellowship with their kind, but the attraction of woodland camps often brings a number together. They are exceedingly fond of salt and persistently return to camps to gnaw logs, boards, or any other object having a salty flavor.

They appear to be practically omnivorous so far as vegetable matter is concerned and feed upon the bark and twigs of spruces, hemlocks, several species of pines, cottonwoods, alders, and other trees and bushes. In orchards and gardens near their haunts they eat apples, turnips, and other fruits and vegetables and visit the shores of ponds for waterlily pads and other aquatic plants growing within reach.

Ordinarily they eat patches of bark from the tree trunks, but sometimes girdle the tree or at times denude the entire trunk. They often remain for weeks in the top of a single tree, even in the severest winter weather. I had a practical illustration of this on one occasion when stormbound in a fur trader's cabin at the head of Norton Bay, on the north coast of Bering Sea, where a belt of spruces reached down from the interior. We were short of meat, and when one of the Eskimos reported that some time before he had seen a porcupine in a spruce tree he was sent to look for it. A few hours later he returned bringing the game, having found it in the very same tree where he had seen it many days before, although we had just experienced a period of severe weather, with temperatures well under 40 degrees Fahrenheit below zero. It was on this occasion that I first learned the palatable qualities of porcupine flesh.

Little is known definitely concerning the family life of these animals. The young, from one to four in number, are amazingly large at birth and appear fully armed with spines. Even before they are half grown they adopt the solitary habit of the adults and wander forth to care for themselves.

Porcupines have an intimate connection with the romantic side of early Indian life in eastern America. Their white quills were colored in bright hues by vegetable dyes known to the Indians and served to make beautiful embroidery on belts, moccasins, and other articles of aboriginal clothing until primitive art gave way to the more tawdry effects of trade goods.

THE JUMPING MOUSE (Zapus hudsonius and its relatives)

(*For illustration, see page 412*)

In several ways the jumping mouse is unique among American mammals. Its strongest characteristics are a dull, rusty yellowish color, a slender body about three inches long, a remarkably slender tail about five inches in length, and long hind legs and feet, which are specially developed for jumping, like those of a little kangaroo. In addition it is provided with cheek pouches, one on each side of the mouth, in which it gathers food to be carried to its hidden stores.

The long tail serves as a balance during its extraordinary leaps, some of which in a single bound cover a distance of about ten feet. If by accident one of these animals loses its tail,

whenever it jumps it is thrown into a series of somersaults, turning helplessly over and over in the air.

The jumping mice form a small group of species and geographic races closely similar in general appearance. They are the sole representatives in North America of the Old World jerboas and are themselves represented elsewhere by a single species occurring in the interior of China. The jerboa family contains in addition many larger and curiously diverse species distributed over a large part of Asia, Africa, and southern Europe. Many Old World jerboas are desert animals, some of them exact reproductions in shape and color of the kangaroo rats of arid regions in the Western and Southwestern States and Mexico, although they are in no way related to those animals.

Jumping mice are distributed over most of the northern parts of North America from the Atlantic coast of Labrador to the Bering Sea coast of Alaska, and southward to North Carolina, Illinois, New Mexico, and California. They are nocturnal in habits and live in or near the borders of forests, in thickets of weeds or brushwood, and in meadows adjoining woodland areas or forest lakes. In prairie country they occupy belts of woody growth bordering streams. In congenial locations they range from sea level up to an altitude of 8,000 feet or more.

For winter homes they dig burrows two or three feet deep, in the lower parts of which they excavate oval chambers and fill them with fine grass and other soft material to make a warm nest. Other chambers opening from these burrows serve as store-rooms for berries, seeds, and nuts of various kinds, among which beechnuts are a favorite.

The nests occupied as summer homes are placed in shallow burrows a few inches below the surface of the ground, or they may be in a hollow tree, under a piece of bark, in a dense tussock of grass, or in other makeshift shelter. In these nests the young, varying from two to eight in number, are born at varying times between May and September, indicating the probability that more than one litter is produced each season.

When suddenly startled from her nest the female often flees with several of the young clinging to her teats. She runs swiftly through the grass, and if hard pressed will take a long leap, still carrying the pendant young. It is surprising that such delicately formed animals can make long leaps in thickly grown places and apparently land safely, especially when carrying their young. In the flights of the mother some of the young must be jarred loose, but when the alarm is over no doubt she returns to find and rescue any that may be missing.

In the northeastern States jumping mice are common habitants of meadows. They are equally at home in the rocky meadows of New England, on the flower-spangled borders of rushing trout streams in the Sierra Nevada of California, and the boggy glades of subarctic Alaska.

My first acquaintance with them was made many years ago, during haying time, in northern New York. Hidden under a haycock, as the last forkful was raised one of them was often revealed, and its startling leaps always resulted in an exciting chase, which usually ended in the escape of the strange little beast.

Unlike most of their small fellows of meadow and thicket, jumping mice regularly hibernate, occupying the nests near the bottoms of the winter burrows. They usually become fat on the abundance of food at the end of summer, and in September or October, with the approach of cool weather, enter their winter quarters and sink into the long, hibernating lethargy. Sometimes two of them are found hibernating in the same nest.

During hibernation they are coiled up in little furry balls, the nose resting on the abdomen, the hind feet on each side of the head, and the tail wound around the body. The winter sleep usually lasts until spring, but may be broken at any time by mild weather.

When hibernating the mice appear cold and lifeless, but if one is carried into a warm house or even held a long time in the captor's hands it will slowly awaken and may become as lively as in summer. When returned to a low temperature, however, it soon resumes its mysterious seasonal sleep.

THE SILKY POCKET MICE (Perognathus flavus and its relatives)

(*For illustration, see page 413*)

Soft, shining fur, delicate coloring, and graceful form distinguish the silky pocket mice from others of their kind. The family of which they are members consists of rodents peculiar to America and includes many other species of pocket mice and kangaroo rats. All are provided with little pouches on each side of the mouth for gathering and carrying food, have proportionately long tails, and hind legs and feet more or less developed for jumping. Only in the most remote way, however, are they related to the jumping mice of the jerboa family.

The silky pocket mice vary in size from the tiny yellow species pictured on the accompanying plate, which weighs much less than an ounce, to forms considerably larger than the common house mouse. The little yellow pocket mouse is one of the smallest mammals in the world, and in addition is one of the most beautiful of our small species. Its bright eyes and the delicacy of its form and color, combined with the readiness with which, in most instances, it appears to lose all fear when caught and gently handled, render it extremely attractive.

As with the majority of other pocket mice, the silky-haired species are limited to the more arid parts of North America, and range from the Great Plains west of the Mississippi Valley to the eastern base of the Cascades, to the Sierra Nevada, and farther southward to the Pacific coast, and from the Canadian border to the Valley of Mexico. Vertically, the range

of these mice extends from sea level to an altitude of more than 7,000 feet.

As with the majority of our wild mammals, little accurate information is available concerning their life history. They are habitants mainly of desert regions, where they prefer the areas of sandy loam, which produce an abundance of scattered desert vegetation. They are nocturnal and by day are seen only when driven from their nests. Their rather shallow burrows are made in soft soil, the situation varying a little with the species. Some species burrow only under the shelter of bushes or other vegetation; others out in the bare ground.

Each burrow commonly has grouped in a small area several entrance holes, which lead through tunnels to the central passageway, the nest, and the storage chambers. Usually there is a little pile of loose dirt thrown out on one side of a hole, or a group of holes may be in a little mound of earth. The entrances are usually stopped from within by loose earth, and if a person quietly thrusts in a short stick so as to remove the earthy plug and let in the light he may see the dirt suddenly returned to its place in little jets, as the occupant promptly kicks the door closed again.

The young, varying from two to six in a litter, are born in these little dens in warm nests of dried grasses. They have been found at all times between April and September, thus making it apparent that several litters are produced each season.

The silky, as well as the other kinds of desert pocket mice, do not drink water, and, as has been shown by experiments, they may be kept for months in thoroughly dry sand and fed on dried seeds without any resulting discomfort. Through the long pressure of desert environment they have developed the power to produce sufficient water for their physiological processes by chemical changes in the starch in their food, which are effected in the digestive tract.

Representatives of this group of mice are almost everywhere in the arid parts of their range, and in many sandy localities are extremely numerous and active at night, as shown by the multitude of little tracks in the dust at sunrise each morning. Their presence in the desert is indicated also by the many little conical pits half an inch or an inch deep, where they have located small seeds and dug them up.

They lie close in their burrows during cold or stormy weather, depending on their stores for food, but are not known to hibernate, although in the northern part of their range they are confined to their burrows for long periods.

At one of my camps in the desert of Lower California I found the silky and other pocket mice excessively numerous and so short of food that they swarmed about us at night with amazing lack of fear. My experiences with them are given in the accompanying account of the spiny pocket mice.

The silky and other pocket mice have many enemies, among the worst of which are the handsome little desert fox and the coyote. Others which continually prey upon them are the badger, skunk, and bobcat, as well as many owls.

THE SPINY POCKET MICE (Perognathus hispidus and its relatives)

(*For illustration, see page 413*)

Pocket mice are divided into several natural groups of species, all having certain characters in common, as a pointed head, lengthened hind feet and legs, and external cheek pouches for carrying food. The spiny group contains numerous species, the smallest of which is about the size of a house mouse and the largest nearly twice that size.

They are more slenderly built than the silky species and have longer tails, with the hairs lengthened along the terminal half, thus giving a slightly brushy or tufted appearance. Their most striking character is the distinctly coarser hair with long scattered guard hairs, like small bristles, which conspicuously overlie the fur on the hinder parts of the body and from which the common name is derived.

The distribution of the spiny forms, although nearly the same as that of the silky ones, is a little more restricted. All belong to the arid or desert parts of the West and Southwest, from South Dakota and middle California southward to Michoacan, near the southern end of the Mexican tableland, and throughout Lower California.

Some species inhabit the scattered growth of plants in sandy areas, but they are more generally characteristic of harder and more rock-strewn soil, rocky mesas, and foothill slopes. There a few species make burrows in open ground, sometimes with a single hole, but most of them make their nests under rocks, in crevices, or in burrows sheltered by such desert bushes as Covillea, Bursera, Olneya, Cercidium, and mesquites.

In these shelters pocket mice make little mounds a few inches high and ten or fifteen inches across. The mounds have several entrances on different sides, one of which generally shows signs of recent use, although by day it is kept closed from within by loose earth. Each of the many-entranced dens is occupied by a single animal. Early in the morning, before the wind fills them with dust, tiny trails are to be seen leading from these doorways toward the nearest feeding grounds and all about their haunts.

The spiny and the silky pocket mice, sharing much the same arid region, have the same food plants and are preyed upon by the same enemies. The food of these mice consists mainly of small seeds, including the wild morning glory, wild sunflowers, wild parsnips, and a multitude of others characteristic of the various areas they occupy.

Pocket mice are strictly nocturnal or crepuscular in habits and appear by day only when disturbed. If the plugged entrance to a burrow is opened, however, it will probably be quickly stopped up again from within by the annoyed householder.

The young, in litters of from two to eight, are born at irregular times according to the latitude and general weather conditions. In the south at least several litters appear to be born each year, the young being noted almost every month.

When camping alone for a few days in the desert near San Ignacio, in the middle of the peninsula of Lower California, I had a unique opportunity to learn something of the peculiarities of the various pocket mice. Three species were abundantly represented, including both the silky and the spiny kinds. They quickly learned that good hunting could be found in and about the tents for the rice grains and other scattered food and promptly took advantage of it.

As soon as approaching darkness began to render objects indistinct, from their burrows among the surrounding bushes they swarmed into camp and were busy throughout the night minutely searching the ground under the shelter tent for every particle of food. In order to see these interesting visitors to better advantage I placed a candle on a small box in the middle of the tent.

Five or six individuals, representing three species, often came within the circle of light at the same time. At first all were shy and when I made any sudden movement would leap in every direction, like grasshoppers, and quickly vanish. The smallest of the species, a member of the silky group, was the shyest of all and remained timid and reserved.

The two larger species, representing both the spiny and the silky groups, were much more bold and quickly became confiding and delightfully friendly. Their attention was promptly attracted to rolled oats which I scattered on the ground in a spot well lighted by the candle.

Sitting quietly close by the bait where the visitors congregated I soon had evidence that among themselves these little beasts are extremely pugnacious. The first to reach the food would fiercely charge the next comer and always try to leap upon its back, at the same time delivering a vicious downward kick with its strong hind feet. Occasionally the newcomer would charge the one already at the food.

When five or six were trying to secure sole possession of the small food pile there was lively skirmishing about the premises, as they alternately attacked and pursued one another over the sand and among the boxes and other camp gear scattered about. Amazingly quick in movements, they would leap now forward, now sidewise, now straight up a foot or more in the air, with almost equal celerity; and the direction of their movements when attacked was often unexpected. When running about on the level sand they had a steady, swiftly gliding motion, which their tracks showed was the result of a series of little jumps.

Both the spiny and the silky pocket mice became so confiding the first night that when I put my hand on the ground palm up with a little rolled oats in it the nearest pocket mouse would run to it, stop for an instant to smell the finger-tips, and then mount and sit quietly on the palm and fill its cheek pouches.

At such times the mice showed no uneasiness, even when raised in my hand to within a few inches of my eyes in order that I might observe their movements more closely. The motions of their front feet when putting food into the pouches were so rapid that it was impossible to follow them. The nose was held just over the food pile, and the cheek pouches would slowly but visibly swell as they were filled until they stood out like little bladders on each side of the head.

As soon as they were full the mice became uneasy to get away and would run from one side of my hand to the other peering down the abysmal depth of three feet to the ground without daring to leap. As soon as my hand was lowered to the ground the mouse darted away to carry the food to its store in the bushes twenty to thirty yards away, quickly to return with empty pouches.

The mice soon became so tame that while they were on my hand or on the ground I could with one finger of the other hand stroke gently the tops of their heads and backs and even pick them up by their tails and suspend them head down. When thus held they remained motionless, their tiny front feet like little closed hands held against their breasts. When lowered and released they would immediately resume the filling of their pouches as though nothing had happened. Several individuals of the dozen or more which made free of the tent had lost part of their tails, so that they could be readily distinguished.

One of these little bobtails was so gentle and confiding that I became much attached to it. It would permit all manner of familiar treatment, such as being picked up by one foot or by the tail, or being turned on its back. With this confidence came a sense of proprietorship in the good things here so suddenly and mysteriously plentiful, as was shown by his attitude toward his fellows.

Again and again when he was filling his pouches from a pile of rolled oats in my hand I lowered it in a gently sloping position within ten or fifteen inches of another mouse gathering food on the ground. Thereupon the little bobtail in my hand would invariably leave the task of filling his pouches and without hesitation leap down on the back of the one on the ground. The surprised animal thus assailed from an unexpected quarter always fled in terror.

After a short pursuit the bobtailed one would come running back and instead of going to the equally inviting pile of food on the ground would come straight to my hand and complete his task. The industry of the little animals appeared to be tireless, as working swiftly they made trip after trip with pouchloads of food to their stores and quickly returned. One night I watched this strenuous work for two hours until I retired.

The abundance and boldness of pocket mice and kangaroo rats at this place led me to believe that there had been a former abundance

Photograph by Howard Taylor Middleton

YOUNG RED SQUIRRELS AND THEIR NEST

These cute little chaps were found cozily at rest in their nest in a pine. They were routed out, however, long enough to have their portraits taken. An effort was made to include the mother, but without success (see page 454).

of their food here, resulting in a large increase in the rodent population, but that it was then becoming scarce through a failure of rain to renew the seed harvest. The invariable outcome in such cases is for the small rodents dependent on seeds and fruits to be reduced by famine until they become rare, where previously they existed in great numbers. This is one of Nature's processes whereby the danger of the overwhelming increase of any species is automatically prevented.

THE POCKET GOPHERS (Geomys bursarius and its relatives)

(*For illustration, see page 413*)

With the exception of the moles no other extensive group of American land mammals is so highly specialized for a peculiarly restricted mode of life as the pocket gophers. They form a strongly marked family, the Geomyidæ, which includes various genera and many species, all very similar in external form, but varying from the size of a large mouse to a massively formed animal equalling a large house rat in weight.

Without exception they are powerfully built for their size, the head and front half of the body being extraordinarily muscled to meet the demands of their mode of life. The broad blunt head is joined almost directly on the body. The eyes are small and have the restricted vision to be expected from animals living underground. The ears are reduced to little fleshy rims about the openings, and the short naked tail is provided with nerves, which render it useful as an organ of touch.

The front teeth are broad, cutting chisels, and on each side of the mouth is a large pocket in the skin used for gathering and carrying food. On the front feet are long claws, which, when not being used to dig or handle earth, are doubled under, against the soles of the feet, so that the gopher walks on the back of them much as the ant-eater walks on its folded claws.

Peculiar to North America, pocket gophers occupy a great area extending from Illinois, Florida, and the Gulf of Mexico to the Pacific coast, and from the plains of the Saskatchewan, in Canada, southward to Panama. Their vertical range within these limits extends from sea level to timber-line, at above 13,000 feet on some of the high volcanoes of Mexico. The family attains its greatest development in that wonderful region of plains and volcanoes lying about the southern end of the Mexican table-land.

In the United States these animals are best known as "gophers," but in the range they occupy in the Southeastern States they are called "salamanders" and in Mexico are widely known as "tuzas." As a rule they frequent treeless areas, but are found also in many

types of forests from among the palms and other trees of the tropical lowlands to the oaks, pines, and firs on the mountain sides.

All members of the family live wholly underground, in many-branched horizontal tunnels, which they are continually extending in winding and erratic courses about their haunts. The tunnels are from two to about five inches in diameter, according to the size of the animal, and while usually less than six inches below the surface, the approaches to the nest and storage chambers sometimes drop abruptly two or three feet below the regular working tunnels to the level of the living quarters. At intervals along the tunnels short side branches are used as sanitary conveniences, thus enabling the occupant to keep the main passageways in a habitable condition.

The courses of the underground workings are roughly indicated on the surface by series of piles of loose earth brought up through short side passages as the tunnels are extended. These little miners' dumps of earth vary with the size of the animal, sometimes containing more than two bushels. The outlets of the passages leading to the surface are kept plugged with loose earth. When these animals are numerous the ground is thickly dotted in all directions with earth piles, and the caving caused by the network of tunnels just below the surface renders walking difficult. The perpetual industry of these rodent miners outclasses that of the proverbial beaver.

Gophers are both diurnal and nocturnal, the gloom of their tunnels scarcely varying except when one of the outlets is temporarily opened. They are averse to light, and if the plug to a freshly made opening is removed the observer may soon catch a glimpse of the owner as he suddenly thrusts his head into view for a moment before again plugging the door with earth.

Gophers dig their tunnels by using their teeth and the strong claws on the front feet. The loose earth is pushed along the tunnel by the head, the palms of the front feet, and the breast in little jerky movements until it is ejected on the surface dump.

Owing to their poor sight, heavy bodies, and short legs, gophers are clumsy and deliberate in their movements and peculiarly helpless in the open. Apparently appreciating this, they rarely venture from their underground shelter by day except when in grain fields or similar sheltering vegetation. Here they sometimes run out two or three feet to cut down a succulent stalk and drag it hastily within the entrance of the tunnel, where it is cut into short sections and placed in the cheek pouches if to be used as food or left on the dump if the object of the cutting is finally to secure the seeds or head of ripening grain.

During the mating season in spring pocket gophers run about clumsily from one burrow to another and may often be seen on the surface by the light of the rising sun. Most of their short trips above ground are made at night, when they sometimes swarm out and wander over a limited territory. Their night wanderings are proved in California by the many bodies which the morning light often reveals in the sticky crude oil on newly oiled roads which the gophers have tried to cross.

From one to seven young are born in a litter, but whether there is more than one litter in a season or not is unknown. The young when about half grown migrate to unoccupied ground sometimes one or two hundred yards from the home location and make tunnels of their own.

The food of pocket gophers consists mainly of tubers, bulbs, and other roots, including many of a more woody fiber. Whole rows of potatoes or other root crops are cleaned up by the extension of tunnels along them. Sometimes the animals follow a row of fruit trees, cutting the roots and killing tree after tree. In grain and alfalfa fields they are great pests, and in irrigated country their burrows in ditch banks often cause disastrous breaks.

The big tropical species sometimes exist in such numbers as to render successful agriculture very difficult. Sugar-cane planters in many parts of Mexico and Central America are compelled to wage unremitting war on them to avoid ruin. I know of an instance on a plantation in Vera Cruz in which thousands were killed during a single season without stopping the damage from these pests, which swarmed in from the adjacent area.

The large external cheek pouches of pocket gophers are used solely for gathering such food supplies as seeds, small bulbs, and sections of edible roots or plant stems and transporting them to storage chambers located along the sides of the tunnels. Food is placed in the pouches by deft sidewise movements of the front feet used like hands, and so quick are they that the motions of the feet can scarcely be detected. The pockets are emptied by placing the front feet on the back ends of the pouches and pushing forward, thus forcing out the contents. In their tunnels gophers run backward and forward with almost equal facility, the sensitive naked tail serving to guide their backward movements.

Pocket gophers are stupid solitary little beasts, with surly dispositions, and fight viciously when captured or brought to bay. This attitude toward the world is justified by the host of enemies ever ready to destroy them. Among their more active foes are snakes and weasels, which pursue them into their tunnels; and badgers, which dig them out of their runways.

They are also persistently hunted day and night by foxes and coyotes. Moreover, by day various kinds of hawks watch for them to appear at the entrances of their dens, and by night the owls, ever alert, capture many.

When one gopher intrudes into the tunnel of another the owner at once fiercely attacks it. In some places I have seen Mexicans take advantage of this characteristic pugnacity by fastening the end of a long string about the body of a captured gopher and then turning it into an occupied tunnel, through a recently made opening. The owner, scenting the intruder, would immediately attack him, the combatants locking their great incisors in a bulldog grip.

The movements of the string would give notice of the encounter, and by pulling it out

steadily both animals could be drawn forth and the enraged owner of the burrow dispatched. In this manner I have known an Indian to catch more than a dozen gophers in a few hours.

Pocket gophers are active throughout the winter even in the coldest parts of their range, but in many places must rely largely on food accumulated in their storage chambers.

Melting snow in the mountains and in the North reveals the remains of many tunnels made through it along the surface of the ground. These snow tunnels are often filled for long distances with loose earth brought up from underground, and after the snow disappears in spring the curious branching earth forms left, winding snakelike through the meadows, are a great puzzle to those who do not know their origin.

In a state of nature pocket gophers are constantly bringing the subsoil to the surface and burying humus. Over an enormous area they exist in such countless thousands that their work, like that of angleworms, is often of the most beneficial character. On bare slopes, however, their work is highly injurious, as it greatly increases erosion of the fertile surface soil and thus has its direct influence in changing world contours.

When civilized man arrives in their haunts and upsets natural conditions with cultivated crops the new food supply stimulates an increase in the gopher population and their activities immediately become excessively destructive and necessitate unremitting warfare against them.

THE KANGAROO RATS (Dipodomys spectabilis and its relatives)

(*For illustration, see page 416*)

The desert regions of western North America have developed several peculiar types of mammals, and among them are none handsomer or more interesting than the kangaroo rats. These rodents, despite their name, are neither kangaroos nor rats, but are near relatives of the pocket mice, which share their desert haunts.

All are characterized by a kangaroo-like form, including small fore legs and feet, long hind legs and feet for jumping, and a tail longer than the body to serve as a balance. In addition, they have large, prominent eyes and are provided with skin pouches on each side of the mouth for use in holding food to be carried to their store chambers.

The color pattern, like the form, of the kangaroo rats is practically uniform throughout the group. Both are well shown in the accompanying plate of *Dipodomys spectabilis,* the largest and most strongly marked species. Its total length is from 12 to 14 inches; most of the other species are much smaller.

Kangaroo rats of many species are distributed over most of the arid and semiarid regions of the United States and Mexico, from Nebraska, Oklahoma, and the Gulf Coast of Texas west to the Pacific coast, and from Montana and Washington southward to the Valley of Mexico and throughout Lower California. They are especially numerous in the southwestern deserts, where they are the oddest and most picturesque of animals.

Although they have no near relatives in the Old World, some of the African and Asiatic jerboas are externally almost perfect replicas of the kangaroo rats in every detail of form, color, and color pattern, even to the tail markings. This extraordinary likeness in appearance of two widely separated and unrelated animals is made doubly significant by the fact that both live in deserts and have similar habits.

Peculiarly desert animals, kangaroo rats live like the pocket mice, without drinking, but obtain the necessary water through their digestive processes. They are most numerous in sandy areas, and there the earth is sometimes so riddled by their burrows as to render horseback riding difficult.

Kangaroo rats are nocturnal and always live in burrows dug by themselves. As a rule they prefer soft or sandy ground, but some species occupy areas where the earth is hard and rocky. The burrows of some species have only one or two entrances with a small amount of earth thrown out, but others make little mounds with several openings, entering usually nearly on a level or at a slight incline. These openings are nearly always conspicuous, and while frequently near bushes, no effort appears ever to be made to conceal them, and a little trail often leads away through the soft earth.

The large *Dipodomys spectabilis,* which lives mainly in New Mexico and Arizona, constructs the most notable of all the dwelling places of these animals. From its underground workings it throws up large mounds of earth, which gradually increase in size with the length of time they are occupied until they are sometimes more than 3 feet high and 15 feet or more in diameter. From three to a dozen burrows enter these mounds, usually at the surface level of the ground, but some are on the slopes of the mound. The mounds, usually located in open ground, with their round entrance holes from four to five inches in diameter, are extremely conspicuous.

Although generally scattered at varying distances from one another, the mounds are sometimes grouped in colonies. Well-worn trails three or four inches broad lead away from the entrances, some to other mounds showing neighborly intercourse and others far away to the feeding grounds, sometimes 200 or 300 yards distant. One of the openings at the side of the mound is usually the main entrance, and by day this is ordinarily kept stopped with fresh earth. Within the mound and farther under ground are dug a series of ramifying passages, among which are located roomy nest chambers and store-rooms for food.

Kangaroo rats are not known to hibernate in any part of their range. They lay up food for temporary purposes at least and do not go abroad in stormy or cold weather. The north-

ern species and those on the colder mountain slopes must make large store against the winter needs. Their food consists mainly of seeds, leaves of several plants, and of little plants just appearing above ground. Tiny cactus plants and the saline fleshy leaves of *Sarcobatus* are often among the kinds gathered for food.

The big *Dipodomys spectabilis* appears to be more social than most of its kind, as several may be caught in a single mound, and, as already said, well-worn trails lead from mound to mound. A little noise made just outside one of these mounds usually brings a reply or challenge in the form of a low drumming or thudding noise, no doubt made by the animal rapidly striking the ground with its hind feet like a rabbit or wood rat.

When caught they at first struggle to escape, but, like a rabbit, do not offer to bite, and soon become quiet. They have from two to six young, which may be born at any season. Nothing appears to be known concerning the number of litters in a year.

When in camp at San Ignacio, in the middle of the desert peninsula of Lower California, I had an unusual opportunity to learn something of the habits of one of the smaller species of kangaroo rat abundant there. The moon was at its full, and in the clear desert air its radiance rendered objects near at hand almost as distinct as by day. Scattered grains of rice and fragments of food on the ground about the cook tent attracted many kangaroo rats and pocket mice.

During several nights I passed hours watching at close range the habits of these curious animals. As I sat quietly on a mess box in their midst both the kangaroo rats and the mice would forage all about with swift gliding movements, repeatedly running across my bare feet. Any sudden movement startled them and all would dart away for a moment, but quickly return.

Although the kangaroo rats did not become so fearless and friendly as the pocket mice, they were so intent on the food that at times I had no difficulty in reaching slowly down and closing my hand over their backs. I did this dozens of times, and after a slight struggle they always became quiet until again placed on the ground, when they at once renewed their search for food as though no interruption had occurred.

One night, to observe them better, I spilled a small heap of rice on the sand between my feet. Within two or three minutes half a dozen kangaroo rats had discovered it and were busily at work filling their cheek pouches with the grains and carrying them away to their store chambers.

While occupied in this rivalry for food they became surprisingly pugnacious. If one was working at the rice pile and another rat or a pocket mouse approached, it immediately darted at the intruder and drove it away. The mode of attack was to rush at an intruder and, leaping upon its back, give a vigorous downward kick with its strong hind feet. Once I saw a pocket mouse kicked in this way. It was knocked over and for a minute or more afterwards ran about in an erratic course, squeaking loudly as though in much pain.

Sometimes the pursuit of one kangaroo rat by another continued for twenty yards or more. By the time the pursuer returned another would be at the rice pile and it would immediately dash at the victor of the former fray and drive him away. In this way there was a constant succession of amusing skirmishes.

Sometimes an intruder, bolder than the others, would run only two or three yards and then suddenly turn and face the pursuer, sitting up on its hind feet like a little kangaroo. The pursuer at once assumed the same nearly upright position, with its fore feet close to its breast. Both would then begin to hop about watching for an opening. Suddenly one would leap at the other, striking with its hind feet exactly like a game cock. When the kick landed fairly on the opponent there was a distinct little thump and the victim rolled over on the ground. After receiving two or three kicks the weaker of the combatants would run away.

The thump made by the kick when they were fighting solved the mystery which had covered this sound heard repeatedly during my nights at this camp. The morning light revealed a multitude of little paired tracks made by the combatants in these battles. Such tracks in the sand have been referred to as the "fairy dances" of these beautiful little animals, but the truth revealed proves them to be really "war dances."

THE BANDED LEMMING (Dicrostonyx nelsoni and its relatives)

(*For illustration, see page 417*)

Banded lemmings are unique among the mouse tribe in their change from the rufous brown, or gray summer coat to pure white in winter. With the assumption of the white winter fur a thick, horny, padlike growth develops on the underside of the two middle claws of the front feet, which is molted in spring when the winter coat is lost. For an animal living in the far North the usefulness of a white coat in winter is evident, but no good reason is apparent for these curious claw-pads.

The summer coat varies remarkably in color and color pattern, and many of the lemmings in their beautiful shades of chestnut, browns, or grays are very handsome. They are more heavily proportioned than field mice and the very long fluffy fur, which completely conceals the rudimentary ears and tail, tends to exaggerate their size.

The banded lemmings form a strongly marked group, containing a number of species inhabiting circumpolar regions. In North America they occur nearly everywhere in the arctic and subarctic parts, including Greenland, most of northern Canada, including the Arctic islands, and a large part of Alaska, including some of the Aleutian Islands.

They range as far northward as vegetation affords them a proper food supply and have been well known to many of the explorers of

those stern northern wilds. To the southward they extend into the subarctic northern forests, where they usually keep to the open barren areas.

Not much is known of their life histories on this continent. They are mainly nocturnal and live in burrows from two to three feet long, ending with a nest chamber four or five inches in diameter, warmly lined with grass and moss. Near the nest there is usually a branch burrow a foot or more long which is used for sanitary purposes and as a place of refuge when the main burrow is invaded.

In the nests during early summer litters generally containing about three young are brought forth. Ordinarily the burrows open in unsheltered places, but in wooded regions may be under a log or beneath a bush or the roots of a tree. No runways lead out from the burrows as is customary with many of their relatives. They are active throughout the winter, making many tunnels along the surface of the ground under the snow, which are revealed when it melts in spring.

These surface tunnels are their foraging roads, safe from most of the fierce storms which rage overhead. At times, however, the snowy shelter is blown away or some other cause brings the lemmings to the surface, where they blunder aimlessly about, soon to be captured by some enemy or to perish from the cold. As their infrequent appearance on top of the snow is usually during storms, the Alaskan Eskimos have a legend that these white lemmings live in the land above the stars and descend in a spiral course to the earth during snowstorms.

Although banded lemmings never become so extraordinarily numerous over great areas as the brown species, they become very abundant at times in the barren grounds of Canada and the Arctic islands and migrate from one part of their range to another. The best observation in regard to this was made by Rae in June at the mouth of the Coppermine River. On the west bank of the river north of the Arctic Circle he encountered thousands of them speeding northward.

The ice on some of the smaller streams had broken up and he was amused to see the little animals running back and forth along the banks looking for a smooth place in the stream, indicating a slow current, where they could swim across. Having found such a place, they at once jumped in and swam quickly to the opposite side, where they climbed out and, after shaking themselves like dogs, continued their journey as though nothing had happened.

During the years I lived in northern Alaska the advent of winter was marked by invasion of the storehouses by many brown lemmings and other mice, but banded lemmings rarely appeared. When occasionally captured alive, the old ones fought viciously, but the young were gentle and quickly became tame and interesting pets. Their skins were highly prized by the little Eskimo girls to make garments and robes for their walrus ivory dolls.

THE BROWN LEMMING (Lemmus alascensis and its relatives)

(*For illustration, see page 417*)

Few small mammals are so well known in far northern lands as the brown lemmings. They form a small group of species having a close general resemblance to some of the field mice, from which, however, they may at once be distinguished by their much heavier proportions, extremely short tails, and the remarkable length of the hair on their backs and rumps.

They inhabit most of the arctic and subarctic lands of both Old and New Worlds. In North America they are known from the northernmost lands, beyond 83° north latitude, to the southern end of Hudson Bay, and throughout most of northern Canada and all of Alaska, including the islands of Bering Sea.

The extraordinary migrations of these lemmings have attracted attention far back in the early history of northern Europe. At intervals, through favorable conditions, they become superabundant over a large area, and then a sudden resistless desire to migrate in a certain direction appears to seize the entire lemming population. The little beasts start in a swarming horde, sometimes containing millions, and traverse the country.

In their travels they appear indifferent to all obstacles and with dogged and unwavering persistence swim the streams and lakes encountered on their way. Similar migrations have been observed at various points in Arctic America, several of them in Alaska, where the lemmings abound on the open tundras.

These migrations sometimes continue for more than one season, the animals meanwhile being killed in countless numbers by disease, by accident in field and flood, and, in addition, through the heavy toll taken from their numbers by their winged and four-footed foes, which always gather in numbers to accompany them.

The migrations sometimes wear out through the diminution in numbers, and sometimes when they reach the sea, as in Norway, they are said to enter the water and swim offshore until they perish. When one of these swarms of rodents passes through a farming district it cleans up the crops and other surface vegetation like a visitation of locusts.

These lemmings do not hibernate, but, active throughout the severest winters, are abroad almost equally by day and by night. Their burrows consist of winding tunnels, often many-branched and with more than one opening. A dry bed of peat or a dense growth of moss is often pierced by a network of them. Well-defined runways often lead away from the burrows or from the entrance of one burrow to that of another.

Their tunnels run everywhere under the snow, with occasional passages leading to the surface. When fierce gales blow away the snow or a winter rain melts it, many lemmings lose touch with their burrows and wander about until they perish from cold or are caught

by some enemy. They are sometimes found several miles from shore, where they have strayed out on the sea ice.

In winter in the fur countries, in company with field mice, they invade storehouses and habitations in search of food. Among their enemies are ravens and all northern hawks and owls, as well as foxes, weasels, lynxes, bears, and other beasts of prey of all degree.

Within their underground tunnels and often in dense vegetation on the surface lemmings make warmly lined nests of grass and moss in which their young, from two to eight in number, are born. The young appear at varying times, thus indicating several litters each year.

When taken alive, the old ones are fierce and courageous, growling and fighting savagely; but several half-grown young brought me during my residence in Alaska proved to be most amusing and inoffensive little creatures. From the first they permitted me to handle them without offering to bite and showed no signs of fear.

They were kept in a deep tin box, from which they made continual efforts to escape. When I extended one finger near the bottom of the box they would stand erect on their hind feet and reach up toward it, using their forepaws like little hands. If my finger was lowered sufficiently they would climb up into my hand and thence to my shoulder, showing no sign of haste, but much curiosity, continually sniffing with their noses and peering at everything with their bright beadlike eyes.

They were curiously expert in walking on their hind feet, holding the body in an upright position and taking short steps. If anything was held just out of reach above their heads, as the point of my finger, they would continue in an erect position for a considerable time. At such times they would reach up with their front paws and often spring up on their hind feet for half an inch above the floor trying to touch it. When eating they sat upright on their haunches, like little marmots, and held the food in their front paws.

THE COMMON FIELD MOUSE, OR MEADOW MOUSE (Microtus pennsylvanicus and its relatives)

(*For illustration, see page 420*)

The Pennsylvania meadow mouse is a small species about as long in body as the house mouse, but much more heavily proportioned. Its head is rounded, the eyes small and beadlike, the legs and tail are short, and the comparatively coarse fur is so long that it almost conceals the short, rounded ears.

It is a typical representative of a group of small mammals commonly known as field mice, or "bear mice," which includes a great number of species closely similar in general appearance, but varying much in size. In England they are termed voles, and large species living about the water in England and northern Europe are known as "water rats."

Field mice are circumpolar in distribution and abound from the Arctic barrens, beyond the limit of trees, to southern Europe and the Himalayas, in the Old World, and to the southern United States and along high mountains through Mexico and Guatemala, in Central America. They occur in most parts of the United States except in some of the hotter and more arid sections.

As a rule field mice prefer low-lying fertile land, as grassy meadows, but the banks of streams, the rank growths of swamps and marshes, the borders of damp woodlands, the grassy places on Arctic tundras, or the dwarfed vegetation of glacial slopes and valleys above timber-line on high mountains furnish homes for one species or another.

Two, and even three, species of field mice are sometimes found in the same locality, but each kind usually occupies a situation differing in some way from that chosen by the others. Some occupy comparatively dry ground and others, like the European water rat, live in marshes and are almost as aquatic as the muskrat. Most species living about the water are expert in diving and in swimming, even under water. In streams inhabited by large trout they are often caught and eaten by the fish.

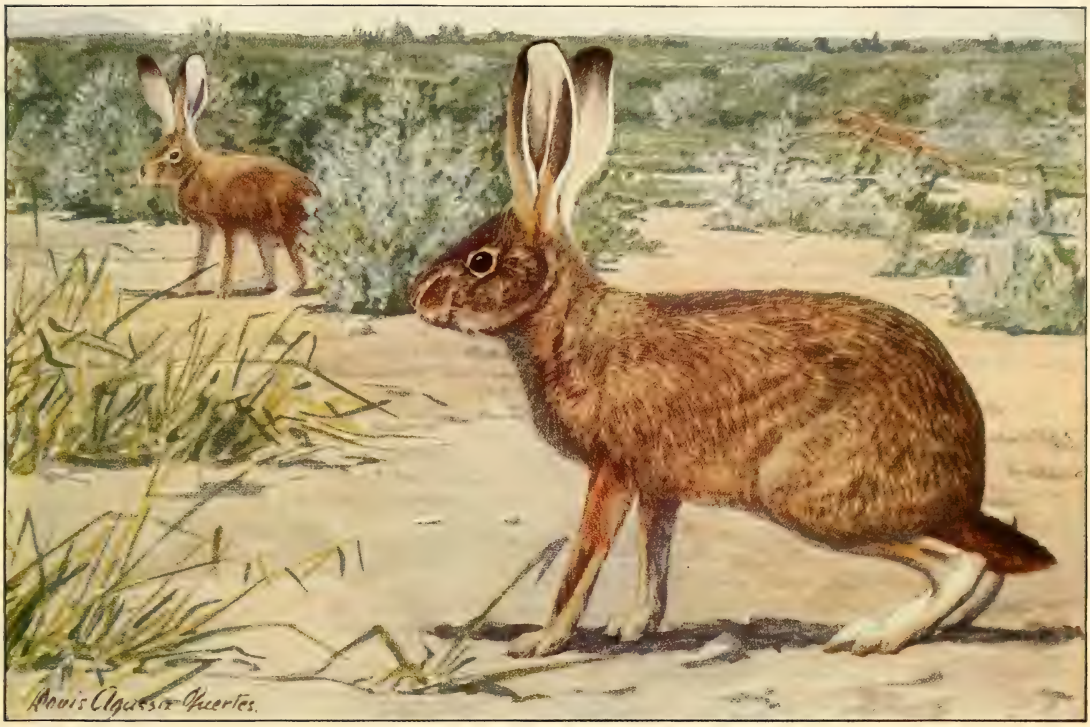
The presence of field mice is nearly always indicated by smoothly worn little roads or runways about an inch in width, which form a network among the vegetation in their haunts. These runways lead away from the entrances of their burrows and wind through the vegetation to their feeding grounds. They are kept clean and free from straws and other small obstructions, so that the owners when alarmed may run swiftly to the shelter of their burrows. Fully conscious of their helplessness, meadow mice are as cautious as the necessities of existence will permit.

Their burrows are often in the midst of grassy meadows, as well as under the shelter of logs, rocks, tussocks of grass, or roots of trees, and lead to underground chambers filled with large nests of dry grass, which shelter the owner in winter and often in summer. The summer nests in many places, especially in damp meadows or marshes, are made in little hollows in the surface or in tussocks of grass. In these nests several litters containing from four to eleven young are born each year.

It is rarely that an observer is located where he can study the every-day lives of little animals like the meadow mice and at the same time go on with his regular occupation. At one of my mountain camps in Mexico I fortunately pitched my tent on a patch of lawn-like grass in front of the ruins of an abandoned hut. Runways of field mice formed a network everywhere in the surrounding growth of grass and weeds.

For hours at a time as I worked quietly in the tent the many mice, unconscious of my presence, came silently along their little roads through the tall vegetation to the border of the short grass. Just within the shelter of the tall growth they would each time stop and remain watchfully immovable for a half minute, and then, if everything was quiet, make a swift run

ANTELOPE JACK RABBIT
Lepus alleni



CALIFORNIA JACK RABBIT
Lepus californicus

VARYING HARE, or SNOWSHOE RABBIT
Lepus americanus

two or three feet into the open, bite off a tender little grass blade and dash back to the sheltered road. There they would sit up squirrel-like, holding the grass blades in their forepaws and eating them rapidly, or would sometimes carry the food back to the burrows.

Occasionally as the mice darted into the open I made a slight squeaking noise and perhaps two or three in sight at the time would instantly turn and dash back into the sheltered road, sometimes not reappearing for a long time. Again and again I saw them come into the open for food, and before securing it suddenly scamper back in a panic without apparent cause for alarm.

Eternal vigilance is the only defense such animals have, and despite their watchfulness myriads of them are devoured daily by a large number of rapacious birds and mammals, including even such huge beasts as the great Alaskan brown and grizzly bears, which dig them from their burrows on grassy northern mountain sides.

Despite their numerous natural enemies field mice are so prolific they continue among the most destructive of agricultural pests. They are so obscure and the damage by a single mouse appears so insignificant, that it requires a knowledge of their habits, their wide distribution, and their enormous numbers to appreciate what a serious drain they are on the farmer's income, even when in their normal numbers.

In summer they feed on growing grass, clover, alfalfa, and grain, seeds, bulbs, root crops, and garden vegetables. In fall they congregate under shocks to feed on the grain, and in winter often do enormous injury to young or even well-grown fruit and other trees by gnawing off the bark on the base of the trunk and roots, sometimes in this way destroying entire orchards and nurseries.

One species in California destroys large quantities of raisins drying in the field by carrying them off to some shelter, where they cut out the seeds and leave the rest of the fruit. I have seen half a pound of raisins under a piece of board, the result of the night's work of a single mouse.

While field mice are always destructive, at intervals they have sudden and mysterious accelerations of increase and become so excessively abundant that they are a veritable plague. Many instances of this are on record in the Old World, where they have become so numerous as to call forth governmental intervention.

The most notable recent outbreak of this kind in the United States took place in the Humboldt Valley, Nevada, where, during the winters from 1906 to 1908, they swarmed over the cultivated parts of the valley and completely destroyed 18,000 acres of alfalfa, even devouring the roots of the plants. During this outbreak the mice in the alfalfa fields were estimated to number as high as 12,000 to the acre.

Whenever field mice become over-abundant notice appears to go out among their natural enemies, and in extraordinary numbers hawks, owls, crows, ravens, sea gulls, coyotes, foxes, bobcats, weasels, and other animals appear to prey upon them.

At no season of the year are they free from their foes, for they remain active throughout the winter, and most species apparently lay up no winter store of food. They travel to winter feeding places through series of tunnels under the snow, and it is mainly at this season that they do the most serious damage to orchards and shrubbery.

In the far North at the beginning of winter they gather in large numbers about the fur-trading stations and other habitations, where they persistently invade the food supplies.

Some of the northern mice, however, gather stores of food for winter. A species living along the coast of the Bering Sea and elsewhere on the Arctic tundra of Alaska accumulates a quart or more of little bulbous grass roots, which are delicious when boiled. They are hidden in nests of grass and moss among the surface vegetation, and before the first snowfall I have seen the Eskimo women searching for them by prodding likely places with a long stick. The roots thus taken from the mice are kept to be served as a delicacy to guests during winter festivals.

THE PINE MOUSE (Pitymys pinetorum and its relatives)

(*For illustration, see page 420*)

The pine mice form a small group of species peculiar to North America and closely related to the field mice. They are similar in form to the common field mice of the Eastern States, but are usually smaller, with much shorter tails and shorter, finer, and more glossy fur.

Most of the pine mice are limited to the wooded region of the States between the Atlantic coast and the eastern border of the Great Plains, and from the Hudson River valley and the border of the Great Lakes south to the Gulf coast. Strangely enough, one species lives in a restricted belt covered with tropical forest along the middle eastern slope of the Cordillera, which forms the eastern wall of the Mexican tableland, on the border between the States of Vera Cruz and Puebla.

Pine mice occupy the borders of thin forests and brushy areas, from which they work out into the open borderlands, especially in orchards or other places where there are scattered trees amid a rank growth of weeds. Instead of making their runways among growing vegetation on the surface of the ground like field mice, they live in little underground tunnels or burrows which extend in all directions through their haunts. These tunnels are closely like those of the common mole except that they are smaller and have frequent openings to the surface, through which the owners make short excursions for food. They often utilize the tunnels of moles when conveniently located for their purposes.

The tunnels are often so near the surface that the ground is slightly uplifted or broken as by a mole, or they are made under the fallen

leaves and other small decaying vegetable matter covering the ground under the trees. Occasionally, when the surface soil becomes dry and hard, the burrows are deeper, so that no surface indications can be discovered. On account of the similarity of their burrows the depredations of pine mice are commonly attributed to moles.

Several inches below the surface pine mice excavate oval chambers to be used for nests or for storage purposes. The nest chambers have several entrances from ramifying tunnels and are filled with short fine pieces of grass, making a warm nest-ball. Here the several litters of young are born each year. Pine mice are less prolific than field mice, however, and the litters contain only from one to four young.

The food chambers are larger than the nest chambers, and when full of stores are kept closed with earth. In these are stored short sections of green or dry grasses, bulbous grass roots, and short sections of other edible roots. One such store contained about three quarts of the fleshy roots of a morning glory cut into short sections.

Pine mice obtain much of their food from the bark about the bases and roots of trees, including both coniferous and deciduous species. They kill many small trees and shrubs by girdling, or by cutting the roots below the surface, and in this way frequently inflict severe damage in orchards and nurseries. Owing to their underground habits they are much more dangerous to orchards than field mice. They also do much damage by burrowing along rows of potatoes and other root crops, upon which they feed.

Both pine mice and field mice are serious pests to agriculture and only by vigilant care can they be prevented from steadily reducing the returns from farm and orchard. A mouse appears so insignificant an enemy that the general inclination among farmers is to ignore it, but both field and pine mice exist in such enormous numbers and are so generally distributed that the aggregate annual losses from them are great.

Clean cultivation in orchards, especially for some distance immediately about the trees, is an excellent protective measure against both of these mice. The shrubbery and fruit trees of orchards, lawns, and gardens may be protected by the use of poisoned baits and traps as soon as signs of pine mice or field mice are observed.

THE RED-BACKED MOUSE (Evotomys gapperi and its relatives)

(*For illustration, see page 421*)

With the exception of the banded lemmings the red-backed mice are the most brightly colored of the smaller northern rodents. They are close relatives of the common field mice, which they about equal in size, but from which they are distinguished externally by rufous coloration, finer and more glossy pelage, larger ears, and proportionately longer tails.

The red-backed mice form a group containing a considerable number of species distributed throughout the northern circumpolar lands, except on the barren islands of the Arctic Sea. In North America they occur from the Arctic tundras north of the limit of trees southward throughout Alaska and Canada to the northern United States. With other northern species of mammals, birds, and plants they follow the high mountain ranges still farther southward to North Carolina, New Mexico, and middle California.

It is true that in the far North they are numerous on the moss-grown tundras, and in the South range above timber-line on high mountains. As a general rule, however, they are woodland animals, whether among the spruces, birches, and aspens of the North or farther south in the United States in the cool fir and aspen-clad slopes of mountains. They also frequent old, half-cleared fields, brush-grown or rocky areas, and similar places where cover is abundant.

Although so closely related to the field mice, the red-backed species are not known to become excessively abundant nor seriously to injure crops. One reason for their harmlessness in this respect may be their strong preference for forest haunts.

I once found them numerous in the grass-grown streets and yards of an abandoned mining camp in the forest at the head of Owens River, in the Sierra Nevada, of California. The mice were making free use of the congenial shelter afforded by the old log cabins, and their runways and entrances to burrows were all about under scattered boards and similar cover.

They are abroad equally by day and by night, and for this reason are better known to woodsmen than most of the small woodland animals. When foraging by day among the fallen leaves and deep green vegetation they present a most graceful and attractive sight, now moving about with quick and pretty ways, now pausing to sit up squirrel-like to eat some tid-bit held in the front paws and then on the alert to detect a suspected danger and poised in quivering readiness for instant flight.

Red-backed mice usually live in underground burrows similar to those of field mice, but generally located with more care in dry situations, the entrances sheltered by a stump, old log, root of a tree, rock, or other object. Ordinarily they do not make such well-defined runways as do many field mice, and sometimes no trace of a trail can be found leading away from their burrows. But where they travel about through small dense vegetation, under logs and about stumps and rocks they often make well-marked trails.

Their nests are bulky and formed of a mass of fine dry grass, moss, and other soft material, which is sometimes located in an underground chamber opening off the burrow and sometimes in hollow stumps and logs or under other surface shelters. But little is known about the home life of these mice except that they are prolific, and between April and October have several litters containing from three to eight young in each.

ARCTIC HARE
Lepus arcticus

COTTONTAIL RABBIT
Sylvilagus floridanus

MARSH RABBIT
Sylvilagus palustris

PIKA, LITTLE CHIEF HARE, or CONY
Ochotona princeps

They feed upon a great variety of seeds, fruits, roots, and succulent vegetable matter and lay up stores for winter in underground chambers or in hollow logs and similar places above ground.

With the coming of winter they gather about cabins and other habitations in their territory and become as persistent as house mice in searching out and raiding food supplies of all kinds. When the more appreciated kinds of food fail they resort to gnawing the bark from roots and bases of trunks of small deciduous trees of various kinds.

During my sledge journeys in the region about Bering Strait I found the skins of many red-backed mice among the Eskimo children. The small boys kept them with lemming skins as evidences of their prowess with miniature dead-fall traps and blunt-pointed arrows, and the little girls kept them as prized robes for the dolls carved by their fathers from wood or walrus ivory.

THE RUFOUS TREE MOUSE (Phenacomys longicaudus and its relatives)

(*For illustration, see page 421*)

The genus Phenacomys, to which the rufous tree mouse belongs, includes a number of species closely similar in size and external appearance to some of the well-known field mice. The structure of their teeth, however, shows that they form a distinct group of animals.

So far as known, the living members of the genus are confined to the Boreal parts of North America, where they range from the Atlantic to the Pacific in Canada, and southward along the mountains to New Hampshire, New Mexico, and northern California. The discovery of fossil representatives of the genus in Hungary and England indicates that it was formerly circumpolar in distribution.

All but one species of the genus live on the ground, inhabit burrows, make runways through the small vegetation, and feed on grasses and other herbage—all in close conformity with the habits of the meadow mice.

The tree mouse, however, is a strongly aberrant member of the group. It differs from all the others, and from all field mice, not only in its rufous color and longer tail, but in its remarkable mode of life. It is restricted to the humid region of magnificent forests in western Oregon and northwestern California, where it often spends its life in the tops of such noble trees as the Sitka spruce, the Douglas fir, and the coast redwood. Such an amazing departure from the habits of its kind lends unusual interest to this little animal.

Its nests are generally located high up in the trees, sometimes 100 feet from the ground, in forests where the branches of neighboring trees interlace so that it can pass from one to another and inhabit a world of its own, free from the ordinary four-footed enemies which prowl below.

The nests vary in size, structure, and location. In Oregon they have been found only in large trees at elevations varying from 30 to 100 feet. On the seashore near Eureka, California, they are placed on the branches of small second-growth myrtle and redwood trees. Farther inland in the same region many are in small trees, within a few yards of the ground, on the border of heavy redwood forests.

The higher nests of the tree mice are often the deserted and remodeled homes of the big gray tree squirrel of that region (*Sciurus griseus*) and contain a foundation of coarser sticks than in the nests wholly built by the mice. The larger proportion of the nests are built by the mice and are usually composed of small twigs, fragments of a netlike lichen, skeletons of fir, spruce, or other coniferous leaves, and the droppings of the mice themselves. They vary from small oval structures a few inches in diameter, located well out on the branches, to great masses close against and sometimes entirely surrounding the tree trunks, supported on several branches, and measuring three feet long and two or three feet high.

The interior of these large structures is pierced with numerous passageways and sometimes as many as five separate nest chambers are scattered through one. Tunnels run out along each of the limbs on which the mass rests, and if it extends all the way round one main tunnel encircles the trunk from which these hallways branch.

Such great nests have evidently been used for a long period and have grown with the steady accumulation of material. This has gradually decayed and become a solid mass of earthy humus. The large nests are usually the abodes of a single female, the homes of the males having been found to be small and more often located away from the trunk of the tree. The food of the red tree mouse, so far as known, consists entirely of the fleshy parts of fir and spruce needles and the bark from coniferous twigs.

Tree mice appear to breed throughout most of the year and have from one to four young in a litter. They are mainly nocturnal, and when driven from their nests by day appear rather slow and uncertain in their movements. Those living in highly placed nests usually escape by running out on the limbs, and pass from one tree to another if necessary. Those in small trees usually drop quickly from limb to limb until they reach the ground, when they run to the nearest shelter.

That these mice sometimes descend to the ground of their own volition is probable, but the fact that the stomach of every individual so far examined has contained only the fleshy parts of coniferous leaves indicate that their food habits have become so fixed as to make arboreal life a necessity.

The modification of the habits of a member of a group of ground-frequenting animals, with a structure adapted to such an existence, to those of a strictly arboreal animal is so strange as to make the question of cause a puzzling one.

In the Hawaiian Islands the introduction of the mongoose has made the common house rat

arboreal in habits, and possibly in the remote past the pressure of some ground-frequenting enemy thus affected the lives of the red tree mouse. An animal rarely makes an abrupt change in its habits without direct pressure from some source, and then only as a matter of self-preservation.

THE MUSKRAT (Fiber zibethicus and its relatives)

(*For illustration, see page 424*)

The muskrat, or "musquash," as it is widely known in the northern fur country, is three or four times the size of the common house rat, to which it bears a superficial resemblance. It has a compactly formed body, short legs, and strong hind feet partly webbed and otherwise modified for swimming. The long, nearly naked, and scaly tail is strongly flattened vertically and in the water serves well as a rudder. The fur is nearly as fine and dense as that of the beaver and, as in that animal, protects its owner from the cold water in which so much of its life is spent.

Muskrats are peculiar to North America, where they exist in great numbers. Aquatic in habits, they have a wide distribution along streams of all sizes and among marshes, ponds, and lakes from the Atlantic to the Pacific, and from a little beyond the limit of trees on the Arctic barrens south throughout most of the United States. They reach our southern border at the delta of the Mississippi and the delta of the Colorado, at the head of the Gulf of California.

Within this vast area they have been modified by their environment into several species and geographic races, none of which differ much in appearance from the well-known animal of the Eastern States.

The nearest kin of the muskrats are the short-tailed field mice, so numerous in our damp meadows. Like the latter, the muskrat has several litters of young each season. The young are born blind, naked, and helpless, and number from three to thirteen to a litter. This great fecundity has enabled the muskrats to hold their own through years of persistent trapping.

They still occupy practically all their original range and yield a steady toll of valuable fur each season. In 1914 more than 10,000,000 of their skins were sold in London, and other millions were handled in America. The aggregate returns on muskrat skins are so great as to constitute it our most valuable fur-bearer. The furriers make its skins up in its natural color or dress and dye it and give it the trade names of "Hudson seal," "river mink," or "ondatra mink."

In suitable marshes, as on the eastern shore of Maryland, muskrats become extremely abundant and render such areas valuable as natural "fur farms." One Maryland marsh containing 1,300 acres has yielded from $2,000 to $7,000 worth of skins a year. Not only are the skins of value, but the flesh is palatable, and is sold readily under the trade name of "marsh rabbit" in the markets of Baltimore, Philadelphia, and elsewhere.

There is little doubt that owners of favorably situated marshes could derive from them a steady revenue by keeping them stocked with proper food plants and protecting the muskrats from their enemies. The value of these fur-bearers is becoming more and more appreciated and many States have laws restricting the trapping season to a period in fall and winter when the fur is prime.

In marshes about shallow lakes or bordering sluggish rivers muskrats build roughly conical lodges or "houses," three to four feet high, with bases, usually in shallow water, several feet broader. These houses are made of roots and stems of plants with a mixture of mud. An oval chamber is left in the interior, well above the water level, to which entrance is gained by one or more passageways opening under water. These shelters are mainly for winter use, but the young are sometimes born in them as well as in large grass nests among dense marsh vegetation.

The curious conical lodges are familiar objects about marshes in the Eastern and Northern States, and I remember seeing, a few years ago, a specially well-formed muskrat house close to the historic bridge at Concord, and others along the Concord River. Within ten years muskrat houses were common in marshy ponds in Potomac Park, Washington, where the Lincoln Memorial Building now stands.

Where the banks of streams or lakes rise abruptly, the muskrats make their home in dry chambers in the banks above water level at the end of a tunnel opening either under water or close to the water level. Worn trails lead up the banks about such places and well-marked runways are made through the heavy reeds and marsh grasses in their haunts.

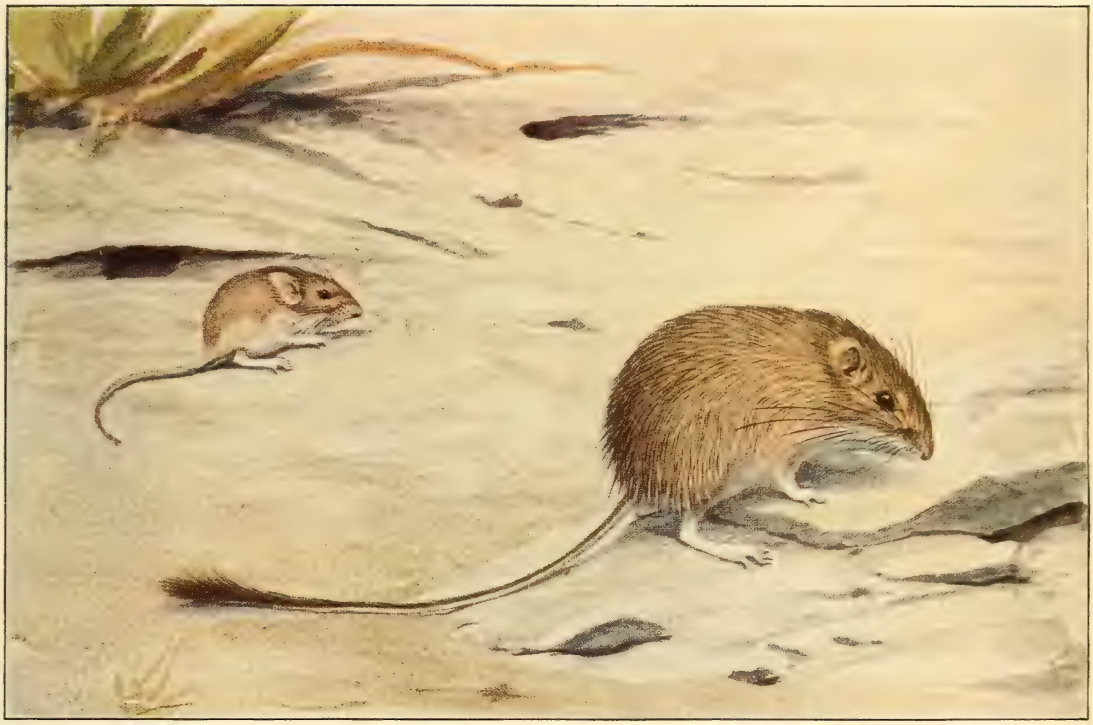
Muskrats are mainly nocturnal animals, but often move about during the day. I have seen them repeatedly swimming close to the bank of the Potomac a short distance above Washington. They like to carry their food to slightly elevated points where they can overlook the water along shore, such as the top of a projecting log, large stone, or earthen bank, from which they plunge headlong at the first alarm. Many a solitary canoeman gliding silently along the shore of stream or pond at night has been startled by the disproportionately loud splash made by a muskrat diving from its resting place.

Their food consists mainly of the roots and stems of succulent plants varied with fresh-water clams, an occasional fish, and even by cultivated vegetables grown in places readily accessible from their haunts. They store up roots and other vegetable matter for winter use and remain active throughout that season. The roots of which their "houses" are built are frequently those used for food and sometimes serve as winter supplies.

As a rule, muskrats keep near their homes in winter, making excursions here and there beneath the ice. Sometimes the water rises and

PORCUPINE
Erethizon dorsatum

JUMPING MOUSE
Zapus hudsonius



SILKY POCKET MOUSE
Perognathus flavus

SPINY POCKET MOUSE
Perognathus hispidus

POCKET GOPHER
Geomys bursarius

forces them out and they wander widely in search of new locations. When encountered at such times they show extraordinary courage and fiercely attack man or beast. The first muskrat I ever saw was one which a farmer met in midwinter in a snowy road in northern New York. As soon as the man drew near, the animal rushed at him with bared teeth and fought savagely until killed.

Muskrats are usually harmless animals and their presence in marshes and along watercourses lends a pleasant touch of primitive wildness to the most commonplace situations. They appear to have so adapted their habits to the presence of men that they go on with their affairs with curious indifference to their human neighbors. In irrigated country or elsewhere where banked ditches are built their habits render them serious pests, as their burrows and tunnels drain ponds or cause destructive washouts.

An interesting chapter in the history of these animals began in 1905, when four Canadian muskrats were introduced on a nobleman's estate in Bohemia. Since then they have increased rapidly and spread over a large area in Bohemia and beyond its borders. The streams in the region they occupy are controlled by grassy banks, and dams are built to form ponds for fish culture, which is a large industry there. The muskrats persistently tunnel into the banks and dams, causing them to give way, thus causing heavy losses to the owners.

They also work havoc among river crabs and mussels, which have great economic value, and interfere with the fish and their spawning beds. To cap the climax of their misdeeds, they are reported to feed on grain and vegetables and to destroy the eggs of domestic poultry and of wild-fowl. It is reported also that these expatriates in their foreign environment have become larger animals than their ancestors, and that their fur has greatly deteriorated in quality. The measures prescribed by the Agricultural Council of the Kingdom of Bohemia for their control are apparently without much success. This instance is a good illustration of the danger attending the introduction of an animal from its native habitat into a new region.

THE WOODRAT (Neotoma albigula and its relatives)

(*For illustration, see page 424*)

In the East known as woodrats, in the West, where much more numerous and better known, these animals are called "mountain rats" or "trade rats." Despite a certain superficial resemblance in size and appearance, woodrats are not related to those exotic parasites, the house rats, with coarse hair and bare tails, but are far more attractive and handsome animals, clothed in fine soft fur, delicately colored above in soft shades of gray, buffy, or ferruginous, while below they are usually snowy white or buffy. The tail is fully haired and in some species almost as broad and bushy as that of a squirrel. Their prominent black eyes and large ears give them an air of vivacious intelligence which their habits appear to confirm.

Woodrats are peculiar to North America, where they occur from Pennsylvania and Illinois to the Gulf coast, spreading thence to the Pacific and as far north as the headwaters of the Yukon, and south through Mexico and Central America to Nicaragua. They are not plentiful in the southern Mississippi Valley and eastward, where they live among cliffs and broken ledges of rock in the deciduous forests, and well deserve their common name. In this region their presence is rarely suspected except by hunters or others familiar with woodland life.

Far more numerous and widely known in the Western States and throughout most of Mexico, they have adapted themselves to life under every climatic condition, from the most sun-scorched deserts of the southwest and the splendid redwood forests of the humid coastal region in northern California to the tropical lowlands farther south.

They live nearly everywhere on the mountain slopes, even to timber-line at 13,800 feet on Mount Orizaba. They thrive in an extraordinary variety of situations, not only where they may find shelter among rocks, but also where they must seek safety in nests made on the surface of the ground or in burrows dug by themselves. They are prolific animals and each year have several litters containing from two to five young.

The presence of woodrats is generally indicated by accumulations of odds and ends filling the crevices of the rocks about their retreats or piled about the entrances of their burrows, such accumulations including small sticks, pieces of bark, leaves, cactus burrs, bones, stones, and any other small objects which may be found in the vicinity.

Sometimes these piles of fragments seem to be made merely for amusement or to work off surplus energy, as they form useless gatherings, such as heaps of small stones, frequently containing a bushel or more, piled on the rounded tops of small protruding boulders in open desert areas, or small heaps of sticks and other material scattered aimlessly about their haunts.

In the desert where cactuses of many kinds abound woodrats' nests are often made at the bases of these or other thorny plants and are covered with such a protective coating of cactus burrs as to deter the most insistent enemy. In the heavy forests of northern California woodrats build huge conical nests of sticks several feet in diameter on the ground, rising to a height of five feet or more.

In southern California and elsewhere some species make great nests of sticks eight to twenty feet from the ground in live oaks and other trees. The stick-pile nests on the ground usually have several entrances, with trails leading from them, and the underground burrows usually have two or more openings.

As may be surmised from their habits, woodrats are skillful climbers, both in trees and on

the rough rock walls of the cliffs they inhabit. Their only notes appear to be shrill squeaks and squeals when quarreling among themselves at night. They also express annoyance or alarm by a rapid drumming on the ground with their hind feet, just as is done by some of the hares and rabbits.

On Santa Margarita Island, in Lower California, I found the most curiously located habitations of these animals I have seen, the bulky stick nests being placed well back in the midst of a mangrove thicket growing in a tidal lagoon. At high tide the mangroves were isolated from shore by several rods of water, so that only at low tide were the rats able to go ashore. In going back and forth they followed certain lines of nearly horizontal mangrove stems, the discoloration on the bark plainly indicating the routes which finally led to dry land by little trampled roads across the muddy ground bordering the shore.

Back a little way from shore others of the same species were living in burrows guarded by orthodox stick and trash-pile nests among the cactuses.

Woodrats, especially in northern localities, gather stores of pinyon or other nuts, potatoes, corn, and any other non-perishable food available to meet the season of storms and scarcity, concealing these supplies in cavities in the nests either above or below the ground. They eat many kinds of fruits, seeds, leaves, and other parts of plants, sometimes including bark of shrubs or small trees and even cactus pads.

As a rule each nest is occupied by a single rat, but sometimes several may be found in one, and the well-worn trails that so often connect the entrances of neighboring nests bear evidence that woodrats have a social disposition. In most localities woodrats are distributed sparingly, but occasionally become so abundant in favorable places on brushy plains that colonies containing hundreds of nests may be found in limited areas. They sometimes become so plentiful about ranches as to make serious inroads on grain and other crops. They also give the Forest Service much trouble by digging up the pine seeds planted in their great reforesting nurseries.

Woodrats are mainly nocturnal in habits and appear to be extremely active throughout the night. Each morning in the vicinity of their nests the light soil shows a multitude of tracks, and in places I have seen little roads in the sand several hundred yards long which they had made by repeated trips to a feeding ground.

No sooner is a cabin built in the mountains than they move in and establish themselves under the floor, or locate a nest near by and use the house as their nocturnal resort. Throughout the night the patter of their busy feet may be heard as they race about on the floor or rustle about the roof, and often over the sleeping forms of their unwilling hosts.

Their activities are sources of mingled amusement and vexation. Small, loose articles, including table knives, forks, and spoons, vanish and all manner of trash, including horse droppings, are brought in, thus establishing their title to the cognomen of "trade rats." If the owner of a cabin leaves it for a few days, he may find on his return that the rats have taken possession and during his absence have tried to fill it with trash of all kinds, in order to make a comfortable home for themselves.

At one cabin in the mountains of New Mexico where I lived one summer several mountain rats made free of the place and at night persistently tried to add our shoes to their nest under the floor. An hour or so after retiring we would hear our shoes scrape slowly across the floor, and in the morning they would be found stuck toe down in the broad crack where the floor ended near the wall. In the woodrat country when small articles are missed from camp it is always worth the trouble to investigate the nearest rats' nests.

Woodrats are plentiful on the Mexican tableland, making their nests under cactuses or thorny agaves, where they are persistently hunted as game by the natives, who prize them as a special delicacy. I saw them regularly sold in the markets of the cities of San Luis Potosi and Aguas Calientes, where the method of marketing them was unique. As soon as they were dug from their nests, their lower incisors were broken off close to the jaw to render them powerless to bite, and then the rats were placed alive in a strong sack and carried to town.

The vendor would sit on a curb at the market and either kill and dress them there or shout his wares by telling every one who passed that he had "country rats; very delicious; live ones; fat ones; very delicious; very cheap." The natives all praised their delicate flavor and one I had served me as a special courtesy was really good, tasting like young rabbit.

THE HARVEST MOUSE (Reithrodontomys megalotis and its relatives)

(*For illustration, see page 425*)

In size, proportions, and color the harvest mice, of all our American species, most closely resembles the common house mouse. Many of them are decidedly smaller than that animal and they rarely, if ever, exceed it in size. They may be distinguished from the house mouse by their browner colors, more hairy tail and especially by a little groove which extends down the front of each upper incisor.

The mice of this group include many species and have a wide distribution ranging from Virginia, in the eastern United States, to the Pacific, and from North Dakota, Montana, and Washington southward through Mexico and Central America to northern South America.

They reach their greatest development in number and diversity of species in the region about the southern end of the Mexican tableland, where I have caught them from the tropical lowlands, near sea level, up to an altitude of 13,500 feet, at timber-line, on Mount Iztaccihuatl.

These delicately proportioned and graceful little beasts are habitants of grassy, weed-

KANGAROO RAT
Dipodomys spectabilis

BANDED LEMMING (*Dicrostonyx nelsoni*)

Summer Winter

BROWN LEMMING

Lemmus alascensis

grown, and brushy locations, mainly in the open country. They are equally at home, however, in the beautiful grassy open forests of oak, pine, and firs which clothe the slopes of the great continental mountain system of Mexico and Central America.

In general they prefer comparatively dry situations, if there is sufficient moisture to produce the needed vegetation, but some species inhabit swamps and even salt and fresh water marshes. Although as a rule not very numerous, at times they are very abundant and make well-worn trails through the small vegetation in their haunts. They are active throughout the year, and in the North, like some other mice, burrow through the winter snows along the surface of the ground in search of food.

So far as man is concerned, most of the harvest mice are among the least offensive of mammals. There are exceptions, however, and, although they rarely approach habitations and as a rule take but slight toll from grain fields and meadows, yet in some areas they become so numerous as to do considerable damage.

Their food includes a great variety of seeds, small fruits and succulent matter mainly from wild plants of no economic value. They lay up stores of seeds in their nests and in little special storage places for severe or inclement weather.

Some of the species dig burrows in the ground where their nests are hidden. Most of them, however, build globular nests of grass and other vegetable matter several inches in diameter in dense grass close to the ground, or up in the midst of rank growths of weeds, or even as high as eight or ten feet from the ground in bushes and low trees.

Sometimes they take possession of convenient sites already provided, such as old woodpecker holes, cavities in fence posts, knot holes, and deserted birds' nests, including the nests of the cactus wren and orchard oriole, which they remodel to suit themselves. Their nests are lined with fine downy material such as the pappus of the milkweed or the cattail flag, and have from one to three small openings usually located on the underside. In these neat homes they have several litters of from one to seven young each year.

Some of their bush nests three or four feet from the ground were found when I was hunting on El Mirador coffee plantation in Vera Cruz. Often on approaching them, the single occupant would dive headlong into the grassy cover below and disappear. But sometimes when disturbed they would come out and run about through the tops of the bushes, leaping from branch to branch with all the agility and graceful abandon of pigmy squirrels. Several times they were seen to stop and sit crosswise on the branches with their tails hanging straight down. When they move about among the branches they sometimes coil the tail around the twig as an opossum might, to give them a more certain hold.

While harvest mice may be seen at their nests by day, they are mainly crepuscular and nocturnal, and so retiring in habits that their presence may be entirely overlooked unless special search is made to locate them. Where found their pretty ways well repay the observer who has the patience to spend a little time with them.

THE GRASSHOPPER MOUSE (Onychomys leucogaster and its relatives)

(*For illustration, see page 425*)

The grasshopper mice are notable for the delicate coloring and velvety quality of their fur. While closely resembling some of the white-footed mice, they may readily be distinguished from them by more robust form, short, thick tail, and the character of the fur.

Only two species, each with numerous geographic races, are known and both are peculiar to North America. Characteristic animals of the arid and semi-arid treeless plains, plateaus, and foothills of the West, their known range extends from Minnesota and Kansas west to the Cascades and to the Pacific coast of southern California, and in the North, from the plains of the Saskatchewan southward to San Luis Potosi, on the tableland of Mexico.

Some races live on the grassy plains west of the Mississippi, but the majority prefer the looser soil and sandy areas of the more arid Great Basin and the even more desert Southwest, where the vegetation is characterized by a scattered growth of woody plants, including many species of cactuses, yuccas, agaves, sagebrush, greasewood, mesquites, acacias, and other picturesque types.

Like other small mammals of the open plains, the grasshopper mice live in burrows. When opportunity offers they evade the labor of digging these for themselves by occupying the deserted holes of mice, kangaroo rats, ground squirrels, prairie dogs, badgers, and other animals. In these retreats they have nests of soft vegetable matter and each season bring forth several litters containing from two to six young.

They are active throughout the year, but nothing appears to be known as to the kind and amount of stores they lay up for winter use. As many live far enough north to experience a long period of cold, with snow covering the earth, there is little doubt that they exercise the same provision in providing stores to meet the need as do many other small mammals.

Many species of mice eat insects or meat and even on occasion devour one of their own kind. The grasshopper mice go far beyond this and are often not only as fierce flesh eaters as real carnivores, but make their diet, at least during the summer season, mainly of insects and other small invertebrates. Their bill of fare includes a miscellaneous assortment of several species of mice, including their own kind caught in traps, small dead birds, lizards, frogs, cutworms, scorpions, mole crickets, ordinary crickets, grasshoppers, moths, flies, and beetles, including the "potato bug."

In addition they eat many kinds of seeds, fruit, and other vegetable matter. Where obtainable, grasshoppers are one of their favorite foods, and from this they receive their common name. In Colorado, from their fondness for scorpions, they are sometimes called "scorpion mice."

Vernon Bailey's observations of a grasshopper mouse he had in captivity are illuminating as to their habits, and indicate that their presence in numbers about cultivated land must be of distinct economic value. When undisturbed and well fed the captive was entirely nocturnal, sleeping all day and becoming very active at night. While usually quiet, sometimes jumping with all his force he tried furiously to escape from his small prison box. His favorite food consisted of crickets, grasshoppers ranking next. Among other things he ate were a black beetle, ladybirds, a potato beetle, spiders, bugs, and dragon flies.

In feeding he sat upright on his haunches and held the insects in his front paws, eating them head first. Large grasshoppers, their tails resting on the ground, were held head up by a paw on each shoulder. A grasshopper would sometimes kick so vigorously as to tip the mouse off its balance, but was never relinquished until decapitated.

The mouse promptly killed and ate a small frog placed in his box and was expert at catching flies. He ate many kinds of insects, including a live wasp, but appeared terror-stricken if a few ants were put in with him. When a dozen or more crickets and grasshoppers were put into his box at the same time he at once proceeded to bite off all their heads before beginning to feast upon them.

A dead white-footed mouse was dropped in and "he pounced upon it like a cat, caught it by the side of the head near the ear, and began biting it with all the ferocity of a coon dog." The bones could be heard cracking and after the little beast appeared satisfied that his prey was really dead he ceased worrying it and an examination showed that he had bitten through its skull deep into the brain. Afterward he tore off and ate fragments of flesh from its head, neck, and shoulders. The ferocious certainty with which he seized the white-footed mouse by the head and bit through its skull indicated that in relation to small mammals he, probably like all his kind, had the predatory instincts and habits of the carnivores.

One morning he ate 12 crickets and a spider in seven minutes and during a single day devoured 53 insects—2 beetles, 8 grasshoppers, 28 crickets, and 15 flies—and appeared ready to take more.

Oddly enough, this grasshopper mouse, so fierce toward small game, never offered to bite when captured or when handled freely, but continued throughout his captivity to have the same friendly confidence in his captor. Others caught in various parts of their range have shown the same characteristics.

At night, especially early in the evening, grasshopper mice utter a fine shrill whistling call note. This habit appears peculiar to them among all the mice and may be likened to that of many of the large beasts of prey in uttering their hunting call as they sally forth for the night's foray.

THE WHITE-FOOTED MOUSE (Peromyscus leucopus and its relatives)

(*For illustration, see page 428*)

Few of our smaller wild mammals are so generally known as the white-footed mice. Usually a little larger and proportionately shorter bodied than the house mice, they may at once be distinguished from them by the contrast between the delicate shades of fawn color, brown, or gray of the upper parts of the body, and the snowy white feet and under parts. Like other members of the genus, they have cheek pouches inside the mouth for gathering and carrying food to their stores.

Their exceedingly quick and graceful movements and their beauty of form and color would make them generally attractive were it not for the prejudice against all their kind resulting from the offensive ways of the house mouse.

Mice of the genus Peromyscus, to which the white-footed mice belong, are peculiar to North and South America and include more species and geographic races than any other American genus of mammals. The white-footed mice are limited to North America. Readily responsive to the influences of environment, they have developed numerous species and a large number of geographic races.

These are spread over most of the continent from the northern limit of trees to the tropical shores of Yucatan. One form has the distinction of living up to an altitude of from 15,000 to 16,000 feet on Mount Orizaba, Mexico, where I found its tracks in the volcanic ashes at the extreme limit of vegetation. This is the highest record for any North American mammal.

White-footed mice are active throughout the year and thrive in every variety of situation. In winter from the Northern States to the Arctic circle the snowshoer traversing the forest will note their lace-work patterns of tiny tracks leading across the snow from log to log or tree to tree. At sunrise on the southwestern deserts their tracks made during the night often form a fine network in the dust, but disappear with the first breath of the morning breeze.

They not only live everywhere in the wilderness, but are prompt to swarm about camps and other habitations, where they make free with the food supplies. Few frequenters of forest camps in the Northern States and Canada have failed to see the bright eyes of these pretty little animals peering at them from some crevice, or the mice scurrying along the log wall like little squirrels.

They are industrious workers and once in a cabin quickly locate some cozy nook in a box or other secluded place to construct a warm nest of any soft fibrous vegetable material

FIELD, or MEADOW, MOUSE
Microtus pennsylvanicus

PINE MOUSE
Pitymys pinetorum

RED-BACKED MOUSE
Evotomys gapperi

RUFOUS TREE MOUSE
Phenacomys longicaudus

available. This completed, they set busily at work nights to raid the food supply of the owner and hide it in suitable storage places, such as a crevice among boxes, an old shoe or a pocket in a garment hung on the wall. Their depredations usually cause so much exasperation that the camper overlooks the grace and beauty of his visitors and makes every effort to destroy them. If the occupants of such camps would keep their supplies in mouse-proof containers and would then feed their woodland friends, they would find them quickly responsive and most attractive guests.

In their native haunts these mice have habits varying with varying conditions. On brushy plains they burrow in the ground, while in the woods they sometimes burrow under rocks, stumps, and logs, or live in hollows in stumps and trees. As nimble in climbing as squirrels, many live in hollow trees sometimes more than fifty feet above the ground.

That our inability to see at night prevents more than an occasional glimpse at the doings of the small animals which often swarm all about us was impressed on me at one of my camps in the desert of Lower California. My blankets were spread under a small leafless tree growing near the base of a rocky ledge, in the crevices of which many relatives of the white-footed mice were living. The first morning in camp I awoke as the sky began to pale and color with the approach of day. The dry branches of the tree a few feet overhead became sharply silhouetted against the sky, revealing several of the mice running up and down them and leaping from twig to twig with all the active grace of tiny squirrels.

The mice appeared to be racing about in pure playful enjoyment of the exercise, and when the light had increased sufficiently to render objects on the ground distinct they suddenly ran down the tree trunk and vanished in a crevice in the rocks. This game was repeated on several succeeding mornings and is no doubt commonly indulged in where conditions are favorable.

White-footed mice feed mainly on many kinds of seeds and nuts and vary this diet with snails, insects, and sometimes with the flesh of dead birds or other mice. As they do not hibernate they lay up abundant stores of grain and seeds of many kinds in addition to a variety of nuts, as acorns, beech nuts, pine nuts, maple seeds, and others, according to the locality. The stores are hidden in hollows in logs, stumps, trees, or in the ground. When in captivity they have shown themselves expert in catching flies, sometimes capturing them with their teeth and again with their front paws used with all the dexterity of little hands.

Several litters of young containing from three to seven each are born, the first usually appearing in spring and the last in fall. The young are blind and helpless at birth, and in this condition cling so tenaciously to the mother's teats that when she is frightened from the nest they are often carried off attached to her.

Some individuals at least of the white-footed mice, like others of the genus Peromyscus, are known to have a prolonged and musical song. It is a fine warbling ditty, a little like the song of a canary. A number of good observers have recorded these performances, but they appear to be so infrequent that most people with woodland experience have never heard them.

The lives of these mice are passed in constant fear of a host of enemies. Hawks and owls, bluejays, and shrikes in the bird world are ever on the alert to capture them, while skunks, weasels, minks, foxes, and snakes persistently seek them in their retreats.

THE BEACH MOUSE (Peromyscus polionotus niveiventris and its relatives)

(*For illustration, see page 428*)

The beach mouse is a beautiful, velvety-furred little creature about the size of a house mouse and one of the smallest species of the genus Peromyscus. Its back is colored with delicate shades of pale vinaceous-buffy and its underparts, including the feet, are snowy white.

The species *Peromyscus polionotus,* of which the beach mouse is one of several geographic races, or subspecies, occupies a comparatively restricted range in the lowland region of Alabama and Georgia and thence through a large part of Florida.

It presents an unusually convincing illustration of the influence of changing environment upon the physical characters of animals. Among the cotton fields of Alabama and Georgia *Peromyscus polionotus* is rather dark grayish brown, but on the lighter-colored soil of Florida the color responds and becomes paler in perfect correspondence with the change in soil until the white sand-dunes and beaches of the coast are reached. There, in strong contrast with the color of the northern members of the species, it is so modified that the pale representatives of this area are recognized under the name *niveiventris,* as a geographic race, or subspecies.

Changes in environment affect both great and small mammals in a variety of ways, sometimes in shades of color, sometimes in relative size, and sometimes in proportions. Exceptions to the rule are to be found, however, and some species of mammals have a wide range under a great variety of conditions, with scarcely an appreciable sign of variation.

The beach mouse is abundant on the sand-dunes and beaches of peninsular Florida, especially from Palm Beach to Mosquito Inlet, wherever there is a growth of sea oats (*Uniola*), which appears to be its principal food plant. It is a nocturnal animal and its nightly activities may be read, early in the morning, from the multitude of tiny tracks which lead in all directions and often form a network on the sand. A single track sometimes extends for a hundred yards or more from a burrow, and with all its windings may aggregate several hundred yards of travel, showing the activity of this small worker during many hours.

Tracks are most plentiful immediately about

growths of sea oats, patches of saw palmetto, or scrubby bushes. The homes of these mice are usually in short burrows sheltered by growing vegetation or under fallen palm fronds.

As in the case of many of our mammals, we have scanty information concerning the life of these attractive little animals, and it is suggested that here lies a pleasant subject for investigation by some nature lover wintering in Florida.

THE BIG-EARED ROCK MOUSE (Peromyscus truei and its relatives)

(*For illustration, see page 429*)

The numerous species of mice of the genus Peromyscus in North America include a great variety of little beasts, many of which are distinguished by beauty of form and color. One of the most striking and picturesque individualities among these is found in the big-eared rock mouse, which is characterized by its great ears, a thick, soft coat of buffy brown fur, and a long, well-haired tail. In size it exceeds the common house mouse and even the white-footed mice which share its haunts.

This rock mouse is indigenous to the mountainous regions of the West, from Colorado and New Mexico to the Pacific and south to the Cape Region of Lower California, and down the Sierra Madre of Mexico to Oaxaca. Within this area it divides into several not very strongly marked geographic races.

As implied by its common name, it is a characteristic dweller among cliffs and ledges along the mountain slopes or rocky canyon walls, where it occupies the many crevices and little caves. In California it ranges from near sea-level up on the mountains to above 10,000 feet altitude. Although showing a distinct preference for rocky places, when available, some races of this mouse adapt themselves to other conditions and may be found on brush-grown flats, where they live in brush heaps, old wood-rat nests, and similar shelter.

That they make their homes in places other than cliffs in New Mexico was evidenced by a thick, soft nest made almost entirely of wool, found in a hollow juniper. They have several litters of from two to six young each year, the breeding period extending from spring to fall.

In Arizona and New Mexico I found the rock mouse most numerous in the belt of junipers and pinyons and in the adjacent yellow-pine forest. The crevices of cliffs about the Moki and Zuni Indian pueblos and in all the rocky wilderness of that region, including the Grand Canyon, are abundantly populated with them.

They search every nook about their haunts and often visit cabins or temporary camps for food, but do not usually take up their abode in them as do the white-footed mice. When foraging their movements are quick, and when startled they make surprisingly long leaps. Like others of their kind, they eat a great variety of seeds and small nuts, quantities of which they lay up in winter stores. Pinyon nuts, and especially juniper seeds, are their favorite food.

While of nocturnal habits, rock mice at times wander forth in sheltered spots by day, and on the few occasions I have seen them I have been delighted with their grace and beauty, their great ears and prominent shining black eyes lending them an attractive air of alert intelligence.

Throughout their lives they are in deadly peril from predatory foes. Hawks and owls glide shadowlike along the faces of their rocky homes ready to pick them up whenever they venture into open view, while bobcats, skunks, and weasels prowl about by night hunting their furry victims.

THE BROWN RAT (Rattus norvegicus and its relatives)

(*For illustration, see page 429*)

It is safe to assume that few readers need an introduction to that world-wide pest variously known as the brown rat, house rat, wharf rat, or Norway rat. Two European relatives, the black rat and the roof rat, preceded the brown rat to the New World and became widely distributed. They resemble the brown rat, but are much smaller and are soon killed, driven away, or reduced to a secondary status by their larger and fiercer cousin, which averages about sixteen inches in length, although large individuals attain a length of more than twenty inches and a weight of more than two pounds. The black rat has nearly disappeared from most of its former haunts in the United States and the roof rat is mainly restricted to southern localities with a mild climate.

Neither the brown, black, nor roof rat has any near relatives among native rats of America, and all may be distinguished from our native animals by their coarser hair and long, naked tails.

The brown rat is believed to have first invaded Europe from Asia in 1727, when hordes of them swam the Volga River, and about the same year it arrived in England on ships from the Orient. Since then, traveling by ships and by inland commercial routes, it has spread to nearly all parts of the globe. In America it is now established in human abodes throughout the length and breadth of the continents from Greenland to Patagonia.

Wherever it goes the fierce and aggressive spirit with which it is endowed qualifies the brown rat more than to hold its own against all rivals, while its mental adroitness and its fecundity have largely nullified the constant warfare being waged against it by all mankind. Not content with infesting ships, dwellings, stores, warehouses, and even the refrigerating rooms of cold-storage plants in many areas, it has established itself as an extremely destructive pest in the open fields.

In towns it hides among stored merchandise, in the hollow walls of buildings, in sewers and other underground passages, or, as in the fields,

MUSKRAT
Fiber zibethicus

WOODRAT
Neotoma albigula

HARVEST MOUSE
Reithrodontomys megalotis

GRASSHOPPER MOUSE
Onychomys leucogaster

in burrows which it digs in the ground. Its nests are soft, warm masses of fibrous material which is secured by raids on any available supply of cotton, wool, or fabrics, which they cut into shreds for the purpose.

In these retreats it has several litters a year, averaging about ten young, but exceptional cases of more than twenty young have been recorded. The young begin to breed when less than six months old. The size and number of litters increase with the food supply, and under favorable conditions rats soon become intolerable pests.

In Jamaica and the Hawaiian Islands rats became so numerous that sugar-cane and other plantations were at one time threatened with complete destruction. To save the crops the mongoose was introduced, but after checking the rats in Jamaica these curious little mammals in turn became a pest which it appears hopeless to control.

In the Hawaiian Islands the mongoose reduced the number of rats, but the survivors promptly took up their abodes in the tree tops, where they now live as completely arboreal lives as squirrels, safe from their ground-inhabiting enemy.

During a two weeks' campaign against rats in the sewers of Paris 600,000 were killed, and on a rice plantation of about 1,200 acres in Georgia 30,000 were destroyed in one season. In Illinois 3,435 were killed on a farm in one month.

One of the most curious chapters in the life of this hardy beast is now developing in the far island of South Georgia, on the border of the Antarctic, east of Cape Horn. On this island, which has a cold and stormy summer and nine months of rigorous winter, several whaling stations have been established. For years great numbers of whale carcasses have drifted ashore each season and, half rotting, half refrigerated, have furnished a never-failing food supply for brown rats that have landed from the ships. With such abundant food they are reported to have increased until they now exist there literally in millions. They make their nests in the tussocks of grass and peat and swarm along well-marked trails they have made on the mountain sides.

In the trenches along the battle front in France they have become extremely abundant and troublesome, and in England have multiplied until the Board of Agriculture is recommending efforts to destroy them as a menace to the public welfare through their waste of food supplies.

On farms, in addition to destroying growing and stored crops, they kill great numbers of young chickens, turkeys, and other poultry, and create havoc with such ground-frequenting game as pheasants. At all times brown rats are more or less carnivorous, and when several are confined in a cage the stronger will soon kill and devour the weaker.

In city department stores and large hotels they often cause thousands of dollars damage yearly in single establishments. An English organization for their destruction estimated in 1908 that, outside the towns and shipping, in Great Britain and Ireland they caused annual losses of about $73,000,000.

When there is a sudden diminution in the food supply, an abundance of which has caused a great increase in the rat population, the rats migrate into other districts, sometimes in enormous numbers. These migrations usually occur at night, and many are matters of history in Europe and in the United States.

A witness of one of these migrations in Illinois in 1903 reported that one moonlight night as he was passing along the roads he heard a rustling in a field near by and soon saw crossing the road in front of him a multitude of rats extending as far as he could see. The following year the invaders became a plague in that district. At times of food scarcity rats become extremely bold and aggressive. Without hesitation they swim streams encountered in their wanderings and at times will even attack man.

Owing to their great numbers, universal distribution, and destructiveness, brown rats are the worst mammal pest known to mankind. Through their habit of living in sewers, among the offal of slaughter-houses, and in garbage heaps, from which they invade dwellings and storehouses, they pollute and spoil even more foodstuffs than they eat.

In addition, they are known carriers of some of the worst and most dreaded diseases, as bubonic plague, trichinosis, and septic pneumonia; while there is little doubt that they spread scarlet fever, typhoid, diphtheria, and other contagious maladies. Bubonic plague is mainly dependent upon rats for its dissemination and has been carried by them to more than fifty countries, including the United States. In India more than two million people have died in one year from this rat-conveyed disease.

Although rats are abhorred by man, yet they have been for ages so closely associated with most of his activities that they have long had their place in Old World literature. Among other instances, many readers will recall Victor Hugo's gruesome account of Jean Valjean's fight with the rats in the sewers of Paris. In England and on the continent rat catching has been a regular trade and dogs have been specially bred for use in their pursuit.

Rats are loathsome vermin which civilized man should eliminate with the other evils of his semi-barbaric days which he is leaving behind. One might still wish that in many places a modern "Pied Piper of Hamelin" would appear and rid the people of these pests. This is not necessary, however, if the public will cease to take their presence as a matter of course. Their exclusion from buildings and destruction are merely matters of good housekeeping, both personal and communal.

Rats can be banished by removing or destroying trash heaps and similar harboring places and by the simple expedient of rat-proofing buildings, especially dwellings, granaries, warehouses, and other places where food supplies are stored.

These precautionary measures should be sup-

plemented by trapping or poisoning in open places. Campaigns of this kind can be fully successful only when engaged in by the community at large. The returns from the investment for such a purpose will be large, not only in the vast money values of property saved, but in the reduction of the death rate and in the great improvement of the public health.

THE HOUSE MOUSE (Mus musculus)

(*For illustration, see page 429*)

The familiar house mouse is of Old World origin and may be distinguished from most of our native mice by its proportionately slenderer body, long hairless tail, and the nearly uniform color on the upper and under parts of the body. Like the house rat, wandering an alien from its original home in Asia, and transported by ship and by inland commerce, it has gained permanent foothold and thrives in lands of the most diverse climatic conditions, except those of the frigid polar regions.

For centuries the house mouse has been parasitic about the habitations of man, and in many places in America has spread into the surrounding country, where it holds its own in the struggle for existence with many of our native species. It is probable that its ability to live in houses also infested by the fierce brown rat is due wholly to its agility, and to the small size, which enables it to retreat through crevices too small for the rat.

In buildings it hides its warm nests in obscure nooks and crannies, making them of scraps of wool, cotton, or other soft fibrous material, often cut from fabrics. Out in the fields, like any other hardy vagabond, it adapts itself to whatever cover may be available on the surface or in crevices and the deserted burrows of other mammals.

It has several litters of from four to nine young each year. The young are born blind, naked, and helpless, but are soon able to run about, often following the mother on her foraging expeditions. When a little more than half grown they usually scatter from the home nest and seek locations of their own.

Throughout most of its world-wide range the house mouse has the same general appearance, but in some localities the effect of changed environment is developing appreciable differences, which appear destined to result in marked geographic races. The representatives of these mice I caught in weedy fields on the coast of Chiapas, near the border of Guatemala, have an appreciable rusty shade on the back in place of the ordinary dull gray.

The success of both the house mouse and the house rat in establishing themselves so successfully in all parts of the world, in the face of the antagonism of mankind, affords marvelous examples of physical and mental adaptability not equaled elsewhere among mammals.

From early days the domestic mouse has been a familiar member of the household with people of all degree, and the housewife has had to match her wits against the cunning persistence of this small marauder in order to safeguard the family supplies of food and clothing.

Despite the antagonism excited by its destructive habits the mouse is so small and often so amusing in its ways that it has commonly been regarded with a half hostile, half friendly, interest. This is apparent by frequent references to it in proverbs, nursery rhymes, fables, and folklore, as well as in more serious literature.

Many cases of singing house mice have been recorded, their notes being a series of continuous musical chirps, trills, and warblings, rising and falling about an octave and slightly resembling the song of a canary. It has been claimed that this singing is due to an affection of the songster's breathing organs, but this can scarcely account for its being uttered at definite times and places and ceasing at the volition of the performer.

In one instance the song had been heard in a china closet and an observer sat by the open door to locate the singer. After patient waiting "a mouse peered out from behind the plates, climbed up a little way on the brackets, and after looking around several times, began to sing." This mouse continued to sing in the same place at intervals for several weeks and became accustomed to the presence of people during its performances; then it suddenly disappeared, probably a victim to one of the dangers which constantly beset its kind.

THE MOUNTAIN-BEAVER (Aplodontia rufa phaea and its relatives)

(*For illustration, see page 432*)

The first adventurous fur traders who penetrated the Oregon wilds found the Chinook Indians provided with robes made of skins of the mountain-beaver. From that time until recently but little accurate information has been available concerning the habits of this curious animal. Locally it is known by several other names, including "Sewellel," "mountain boomer," "boomer," and, in the Olympic mountains, "chehalis."

The genus of mountain-beavers contains only a single species with several subspecies, all having a close superficial likeness in size and form to a tailless muskrat, except for their coarse, harsh fur. It is an exclusively North American type and, aside from a remote relationship to the squirrel family, has no kin among living mammals. It appears to be a sole survivor from some former age. As with the pocket gophers, its mode of life has developed powerful muscles about the head, front legs, and forepart of the body.

The distribution of the mountain-beaver in Tertiary times extended through the Great Basin to North Dakota, but at present is closely restricted to the humid region between the crests of the Cascades and the Sierra Nevada and the Pacific coast, and from the lower Fraser River, British Columbia, south to the latitude of San Francisco Bay, California.

Within this superbly forested region this ani-

WHITE-FOOTED MOUSE (Adult and Young)
Peromyscus leucopus

BEACH MOUSE
Peromyscus polionotus ni-vei-ventris

BIG-EARED ROCK MOUSE
Peromyscus truei

BROWN RAT
Rattus norvegicus

HOUSE MOUSE
Mus musculus

mal delights in locations that are cool and oozing with water, where, under the dense shade of an almost tropical undergrowth of shrubs, ferns, and other herbage, it constructs numberless tunnels and trails. These are sometimes in flats, but much more often along canyons and mountain slopes, among willow, alder, aspen, or other thickets, or even in the heavy coniferous forest.

Veritable colonies inhabit certain areas and the ground is honeycombed with burrows six to eight inches in diameter and covered with a network of surface trails. The irregular branching tunnels are sometimes two or three hundred feet in length and have at frequent intervals side passages through which the earth mined in extending the burrow may be ejected in small dumps. The tunnels appear in a large measure built for the safety of the owner in traveling, since they repeatedly come to the surface at the end of a log, where an open, neatly kept trail extends under its shelter the entire length, the tunnel being resumed at the far end of the log.

All surface runways connecting tunnel entrances or leading through the thick surface vegetation are well kept and free of all obstructions. The ground in these haunts is commonly so saturated with water that the tunnels form drainage channels down which run little streams.

Nest chambers discovered by T. H. Scheffer in the Olympic Mountains were located in tunnels two feet underground. They were oval in form and one measured eighteen inches in horizontal diameter and seventeen in height. Here three storage chambers opened directly from the nest chamber, one of which contained two quarts or more of sections of fern roots, which had been kept so long they were spoiled, and another was partly filled with freshly cut leaves of nettles and twigs of cedar and fir. At the far end an opening dropped six inches into a small drainage basin partly filled with water, out of which led two passages. The roofs of the chambers were lined with a thin layer of clay, which appeared to have been packed in place by the owner.

In the upper and drier part of the nest, which was made of dried fronds of ferns, grasses, and small twigs, were found three young less than a week old, with coats of fine fur, but with eyes still closed. Like burrowing animals generally, the mountain-beaver is cleanly in its housekeeping, and offal, loose dirt, and debris of all kinds are pushed out by the forefeet and head to the dumps at the less-used openings.

In winter much of the mountain-beaver country is buried under several feet of snow, but this does not stop the activities of this hardy animal. Between the entrances to its burrows and out along the surface of the ground it tunnels through the snow in various directions in search of forage.

At this time it cuts twigs from bushes and gnaws the bark from the trunks and roots of the smaller trees, sometimes completely girdling and killing trees more than two feet in diameter. Its underground tunnels are also extended at this season, the soils being pushed up in dumps under the snow and parts of the snow tunnels are packed full of it for some distance, so that when the snow disappears the curious earth-forms remain like those of the pocket gopher.

The mountain-beaver lives a monotonous existence and correspondingly lacks the mental vivacity of many other species which have a greater freedom of movement. When one is caught it shows little fear, but struggles to escape, growling, clattering its teeth, and biting viciously at anything within reach. Its desire for food, however, appears to control its emotions, and very soon after being captured it will eat any green vegetation offered, as unconcernedly as though free.

That the mountain-beaver possesses social instincts is evident, as a pair is often found occupying one set of tunnels, and in many favorable places a number will have their burrows closely grouped and connected with a network of communicating surface trails.

Although mainly nocturnal, the animals are active early in the morning and late in the afternoon, as well as throughout dark days. Those kept in captivity would show periods of restless activity at night and have alternating periods of sleep and wakefulness during the day. Sometimes they would sleep coiled with the head turned under the body and again flat on their backs. During these periods their sleep is often so profound that they may be handled without being awakened.

One captive animal is reported to have uttered a curious quavering note resembling that of a screech-owl. They have a strong musky odor, which is very evident when they are first caught, and which is frequently apparent about the burrows.

Careful and repeated efforts to keep these animals in captivity under as near normal conditions as possible in regard to food and surroundings in the vicinity of where they were captured have, up to the present time, resulted in failure. In every case the animals failed to thrive and soon died.

The mating occurs about the middle of March, and a month later litters of two or three young are born. The young grow slowly, not attaining full size for a year or more, and do not breed until the second year, but they leave the shelter of the home nest and scatter to occupy burrows of their own at the end of the first two or three months.

The mountain-beaver feeds upon nearly all small vegetation growing in its haunts, including, in addition to small herbage, shrubs, the bark of trees and bushes, ferns, and fern roots. More than thirty species of native plants have been found among its "hay" piles at the mouths of burrows. Since its country has become increasingly occupied by farmers, it has developed a fondness for cultivated crops that, in many places, is rendering it a pest. It appears to have a special taste for cabbage, potato, and onion tops, and other garden produce.

When gathering its food it sits up squirrel-

like and grasps the plant stem with one hand, a long projecting tubercle on the "heel" of the hand opposing the fingers like a thumb and giving a good grasp, so that it can pull plants down to be bitten off with the sharp front teeth. Sometimes it climbs up a few feet into a bush or small branching tree after succulent shoots.

The mountain-beaver has the interesting habit of gathering stores of green plant food much like that of the cony on the mountain tops, but appears to be more methodical in its ways, gathering the stems of such plants as grasses, ferns, and lupins, as well as twigs of various bushes and carrying them in bundles as large as can be held in the mouth, the butts of the stems neatly laid together. These little bundles of "hay" are placed side by side about the entrances of the burrows, with the butts all parallel on sticks or other support to keep them as clear as possible from the ground. They are left thus for a day or more to cure before being carried into the subterranean store-rooms.

Chief among the four-footed enemies of the mountain-beaver are the fisher and bobcat, and an eagle has been seen keeping close watch at the entrance of their burrows.

THE COMMON WOODCHUCK, OR AMERICAN MARMOT (Marmota monax and its relatives)

(*For illustration, see page 432*)

The woodchuck or "groundhog" is a typical marmot, with coarse hair, heavy body, short neck, short, bushy tail, powerful legs, and feet armed with strong claws for digging. When fully grown it averages about ten pounds in weight. Its usual color is a grizzled brown, but in some districts black, or melanistic, individuals are not uncommon.

Marmots are common to Europe, Asia, and North America. The group contains many species and geographic races varying in size and color. The Alpine marmot of Europe is probably the most familiar of the Old World species and the woodchuck the best known in America.

North America contains several species of marmots, their joint territory extending from coast to coast over the northern parts of the continent and from southern Labrador, the southern shores of Hudson Bay and Great Slave Lake, and central Alaska southward to northern Alabama, and along the high mountains to New Mexico and the southern Sierra Nevada of California. The common woodchuck is well known to every dweller in the countryside of the Eastern States and Canada, where it occurs from sea-level to near the tops of the highest mountains, at altitudes of over 4,000 feet.

It is a familiar habitant of fields and grassy hillsides, especially where bordering woodland offers safe retreat. In such places it digs burrows under stone walls, rocks, ledges, old stumps, or even out in the open grass-grown fields. It commonly lives in the midst of the forest, where its dens are located in a variety of situations. The burrows are marked by little mounds of earth at the entrances and ordinarily contain from twenty to forty feet of branching galleries, one or more of which end in a rounded chamber about a foot in diameter, well lined with dry grass and leaves.

Within these warm nests the females bring forth from three to nine blind and helpless young about the last of April or early in May. A few weeks later the young appear about the entrance of the burrows sunning themselves and playing with one another, but usually ready to disappear at the first alarm. At times, however, they are surprisingly stupid and may be captured with ease. Woodchucks have practically no economic value. Their flesh, while occasionally eaten, is little esteemed, and their coarsely haired pelts are worthless as fur.

The woodchuck is a sluggish and stupid animal, which does not ordinarily go far from its burrow, but at certain seasons, especially in spring, wanders widely, as though looking over its territory before locating for the summer. It has much curiosity and often sits upright on its hind feet to look about, remaining for a long time as motionless as a statue. When one is driven into its burrow, if a person approaches quietly and whistles, it will often raise its head in the entrance and look about to satisfy its curiosity.

Its only note is a short shrill whistle, which it utters explosively at frequent intervals when much alarmed. At such times it also chatters its teeth with a rattling sound as owls sometimes clatter their beaks.

Owing to their mainly diurnal habits and persistence in living in and about the borders of fields, woodchucks are among the most widely known of our smaller mammals, and have long been the favorite game of the country boy and his dog. When cornered they will fight savagely and with their strong incisors inflict severe wounds.

They feed on grasses, clover, and other succulent plants, including various cultivated crops, especially vegetables in field and garden, where they sometimes do much damage. The holes and earth mounds they make in fields, in addition to feeding on and trampling down grasses or grain, excite a strong feeling against them, and farmers everywhere look upon them as a nuisance. In New Hampshire so great was the prejudice against them that in 1883 a law was passed placing a bounty of ten cents each on them: "*Provided*, That no bounty shall be paid for any woodchuck killed on Sunday."

Unlike many rodents, the woodchucks do not lay up stores of food for winter. As summer draws to an end they feed heavily and become excessively fat. On the approach of cold weather they become more and more sluggish, appearing above ground with decreasing frequency until from the end of September to the first of November, according to locality, they retire to their burrows and begin the long hibernating sleep which continues until the approach of spring.

MOUNTAIN-BEAVER
Aplodontia rufa phaea

COMMON WOODCHUCK, or AMERICAN MARMOT
Marmota monax

HOARY MARMOT, or WHISTLER
Marmota caligata

Some time between February and April, according to latitude, they come forth to resume their seasonal activities. In the northern parts of their range they usually come out several weeks before the snow disappears and may be tracked in it as they wander about searching for food or a new location.

The prominence of the groundhog as a popular figure in the country lore of the Eastern States is shown by his having been given a place with the Saints on the calendar, February 2 being widely known as "Groundhog Day." It is claimed that on this date the groundhog wakes from his long winter sleep and appears at the mouth of his burrow to look about and survey the weather. If the sun shines so that he can see his shadow, bad weather is indicated and he retires to resume his sleep for another six weeks. Otherwise, the winter is broken and mild weather is predicted. Even on the outskirts of Washington some of the countrymen still appraise the character of the coming spring by the weather on "Groundhog Day."

THE HOARY MARMOT, OR WHISTLER (Marmota caligata and its relatives)

(*For illustration, see page 433*)

The whistler is the largest and handsomest of the American marmots. It is similar in proportions to the common woodchuck, but averages nearly twice its weight. Its fur, far thicker and of a better quality, might have a value in the fur trade if enough of the skins were available. As it is, the skins are used only for robes and sometimes for clothing by the Indians.

The distribution of this characteristic animal of the northern Rocky Mountains and outlying ranges extends from the Endicott Mountains, fronting the Arctic coast of Alaska, and the peninsula of Alaska, southeasterly to the Bitterroot Mountains of Idaho, Mount Rainier, the Olympics of Washington, and Vancouver Island. In the North its range extends from above timber-line down over bare slopes and through glacial valleys to the sea-level along the southern coast of Alaska. To the southward it is limited wholly to the higher elevations, usually above timber-line.

Owing to variations in climatic conditions and to isolation in different parts of its range, several geographic races of the whistler have been developed. In the mountains to the southward of its range other marmots occur as far as New Mexico and California.

When the French-Canadian voyageurs on their fur-trading expeditions first visited the Rocky Mountains they encountered the hoary marmots and applied to them the name "siffleur," or whistler, which they had already given the common woodchuck of eastern Canada. The shrill note of the hoary marmot, under favorable circumstances, may be heard more than a mile and justifies the restriction of the name whistler to it.

The whistler lives in such remote and unfrequented districts that little is known of its life history. It is diurnal in habits and loves the free open spaces of the high mountain ridges. There its loud, oft-repeated call note, striking colors, together with its habit of running about on the snowbanks, render it unusually conspicuous.

High in the mountains it usually inhabits rock slides, the tumbled rock masses of glacial moraines, or rocky points, but sometimes takes up its abode on open earth slopes or in the bottoms of little glacial valleys. Ordinarily the dens are hidden in the rock slides and broken-down ledges, or burrows are dug under the shelter of large boulders and even in open ground away from any rocky shelter.

During the sunny days of summer the whistler regularly frequents the top of some conspicuous boulder or projecting rocky point, from which it commands a sweeping view of all its surroundings. Its sight and hearing are extraordinarily keen, and when perched on its lookout it is difficult to stalk. When one has its burrow located in an open place it often sits upright on its haunches to look watchfully about, and at the first alarm disappears into its den. This watchfulness is necessary, for even in the remote alpine highlands it occupies, the whistler is beset by enemies. The most formidable of these are the great brown and grizzly bears of the North, which dig it from its burrow. In addition prowling wolves, Canada lynxes, wolverines, and eagles take occasional toll from its numbers.

Toward the end of summer, when the high alpine slopes are thickly grown with small flowering herbage, the whistler feeds heavily on many of the plants and, like the woodchuck at this season, becomes excessively fat. Before the arrival of winter it retires to the shelter of its den and begins the long hibernating sleep which may last six months or more. In spring, before the snowy mantle is gone from the mountains, it is out, ready to welcome the approaching summer. A few weeks later the three or four young are born. They remain with the mother throughout the season and during their first winter may hibernate in the home den.

The unspoiled wilderness of remote northern mountain slopes and ridges where the whistler lives is also the home of the mountain sheep, caribou, and huge northern bears. As the hardy sportsmen roam these inspiring heights in search of game their attention is constantly attracted to the marmots, whose presence and shrill call notes lend a pleasing touch of life to many an otherwise harsh and forbidding scene.

THE PRAIRIE-DOG (Cynomys ludovicianus and its relatives)

(*For illustration, see page 436*)

Prairie-dogs are not "dogs," but typical rodents, first cousins to the ground squirrels, or spermophiles. As a rule, they may be distinguished from the ground squirrels by their

larger size, proportionately shorter and heavier bodies, and shorter tails. In length they vary from fourteen to over seventeen inches, and in weight from one and one-half to more than three pounds.

These rodents are limited to the interior of North America and form a small group of five species and several geographic races. Although closely alike in general form and habits, the species are divided into two sets: one, the most widely distributed and best known, having the tails tipped with black, and the other having the tails tipped with white.

On the treeless western plains and valleys from North Dakota and Montana to Texas and thence west across the Rocky Mountains to Utah and Arizona, they are one of the most numerous and characteristic animals. Southward they range into northwestern Chihuahua and one species occupies an isolated area on the Mexican table-land in southern Coahuila and northern San Luis Potosi, Mexico. Their vertical range varies from about 2,000 feet on the plains to above 10,000 feet in the mountainous parts of Colorado and Arizona.

Owing to their diurnal habits, their exceeding abundance over vast areas, and their interesting mode of living in colonies, prairie-dogs have always attracted the attention of travelers and have become one of the most widely known of our smaller mammals. All who have lived in the West, or who have merely traversed the Great Plains on the transcontinental railroads, have had their interest excited by these plump little animals sitting bolt upright by the mounds which mark the entrances to their burrows, or scampering panicstricken for shelter as the train roars through their "towns."

So strong is the gregarious instinct in prairie-dogs that they customarily make their burrows within short distances of each other, varying from a few yards to a few rods apart. The inhabitants of these communities, or "towns," as they have often been termed, vary in number from a few individuals to millions. In western Texas one continuous colony is about 250 miles long and 100 miles wide. In the entire State of Texas 90,000 square miles are occupied by prairie-dogs, and the number of these animals within this area runs into the hundreds of millions. The extent to which they occupy parts of their territory is well illustrated by one situation in a mountain valley, containing about a square mile, in eastern Arizona, which by actual count contained 7,200 of their burrows.

The burrows, from four to five inches in diameter, are usually located on flat or gently sloping ground. They descend abruptly from eight to sixteen feet, then turn at a sharp angle and extend ten to twenty-five feet in a horizontal or slightly upward course. The tunnel at the end of the steep descending shaft is always more or less irregular in course, and branches in various directions, the branches often ending in a rounded nest or storage chamber, but sometimes forming a loop back to the main passageway. Not infrequently two entrances some distance apart lead to these deep workings. A little niche is ingeniously dug on one side of the steep entrance shaft, four to six feet below the surface, to which on the approach of danger the owner retires to listen and determine whether it may or may not be necessary to seek safety in the depth of the den. It is from these vantage points that the resentful voices of the habitants come to an intruder in a prairie-dog "town" as he passes.

The black-tailed prairie-dog, which is so numerous on the Great Plains, surrounds the entrance to its burrow with a crater-shaped pyramid of soil varying from a few inches to nearly two feet in height and serving perfectly as a dike to keep out the water. The owners keep the funnel-shaped inner slopes of the rims about the entrances in good condition by setting briskly to work to reshape them at the end of a rain-storm, digging and pushing the earth in place with their feet and molding it into a more compact mass by pressing it in with their blunt noses.

The white-tailed prairie-dogs pile the dirt from their excavations out on one side of the entrance, as in the case of most other burrowing animals. Sometimes the dirt in these piles amounts to from ten to twenty bushels, thus indicating extended underground workings.

The vivacity and hearty enjoyment of life by the occupants of a prairie-dog "town" is most entertaining to an observer. With the first peep of the sun above the horizon they are out on the mounds at the entrances of their burrows, first sitting erect on their hind feet and looking sharply about for any prowling enemy. If all is well they begin to run about from one hole to another, as though to pass the compliments of the day, and scatter through the adjacent grassy feeding ground.

The favorite food of prairie-dogs consists of the stems and roots of gramma grass and other richly nutritious forage plants. In addition they eat any native fruits, such as that of the pear-leaved cactus (*Opuntia*) and are extremely destructive to grain, alfalfa, and other cultivated crops. In addition to ordinary vegetation, they eat grasshoppers and are fond of flesh, sometimes being caught far from their homes in traps set for carnivores. They keep the grass and other vegetation cut down or entirely dug out over much of the "town" and especially in a circle about each entrance mound, apparently for the purpose of obtaining a clear view as a safeguard against the approach of any of their many four-footed enemies. This habit is exceedingly injurious to the cattle ranges and often results in much erosion of the fertile surface soil.

The vast numbers of prairie-dogs over so large a part of the grazing areas of the West take a heavy toll from the forage and other crops. As a consequence a campaign of destruction is being waged against them as the country becomes more and more settled, and they will eventually disappear from much of their present range. However detrimental they

PRAIRIE-DOG
Cynomys ludovicianus

STRIPED GROUND SQUIRREL
Citellus tridecemlineatus

CALIFORNIA GROUND SQUIRREL
Citellus beecheyi

ANTELOPE CHIPMUNK
Ammospermophilus leucurus

may be from an economic point of view, they are among our most interesting species, and when taken young their playful disposition and intelligence render them most entertaining captives.

Owing to the constant danger to which they are subject from coyotes, foxes, bobcats, badgers, and black-footed ferrets, in addition to eagles and other birds of prey, prairie-dogs are constantly on the alert. At any suspicious occurrence the first to observe it runs to his entrance mound, if the danger is not pressing, but otherwise to the nearest mound, where he sits up at his full height, "barking" and vibrating his tail, ready, if necessary, to disappear instantly. At the same time the "town" is alive with scurrying figures of the habitants rushing panic-stricken for their homes, and the air is filled with a chorus of their little barking cries. When all have been frightened to cover barking continues in the burrows, but an hour or more may pass before a "dog" will reappear.

I once stalked a solitary antelope by creeping flat on the ground through a prairie-dog "town." As I drew near the first burrows, the "dogs" all rushed to their mounds, sitting there and barking at the queer and unknown animal thus invading their precincts. The strange sight excited as much curiosity among them as alarm. As I approached one mound after another the owners would become almost hysterical in their excitement and would sit first on all fours and then stand up at full height on their hind feet, the tail all the time vibrating as though worked by some mechanism, while the barking continued at the intruder as rapidly and explosively as possible. When I came within six or eight feet the "dog" would dive down his hole, sputtering barks from the depths as he went, but often would pop up again to take another look before finally disappearing. In this way I passed ten or a dozen mounds while the dozens of "dogs" off my line of progress worked themselves into a frenzy of curiosity and protest. When the stalk was finished I passed back through the "town" and my upright figure was promptly recognized by the habitants as that of an enemy and every one disappeared before I was within fifty yards of the first mound.

The common note of the black-tailed prairie-dogs is a squeaking "bark," much like that produced by squeezing a toy dog; in addition, there is a rapid chattering note, often given as the "dogs" vanish down the hole. The white-tailed species have a shriller, more chirping note. In both species the odd vibrating motion of the tail, held stiffly close to the back, is characteristic.

Prairie-dogs hibernate in severe weather, those living in high, snow-covered mountains or in the far north sometimes sleeping through five or six months. In many places their hibernation is irregular, and near the southern border of their range is limited to a few inclement days now and then. In Wyoming they come out the last of March or early in April, sometimes when there is a foot or two of snow on the ground and the temperature ranges far below zero. Under such conditions they run about over the snow during the middle of the day, feeding on projecting tips of vegetation or digging to the ground.

Beginning near the southern border of their range and proceeding north, the single litter of the season, containing from four to six young, are born in March, April, or May, and a month later, when scarcely larger than chipmunks, may be seen playing about the entrance mound. When danger appears the mother sends the young helter-skelter for the refuge of the burrow, and should any be slow about going in she rushes at them, driving them to cover with shrill barks of alarm. When about half-grown the young scatter and prepare burrows of their own. Sometimes as many as six to nine of these animals may be found in a single burrow, in which, no doubt, they have taken refuge, or it may be a reunion of the season's family.

On warm sunny days, especially at a time when nights are frosty, these fat little animals will often lie flat on the bare ground about their mounds, with legs outstretched, basking in the grateful rays. As their colonies expand by the rapid increase of their numbers, many individuals wander far in search of new locations. On the mountain plateaus of northern Arizona I know of instances where they have traversed several miles of pine and fir forest to locate in an isolated mountain park, and new colonies were established as far as six miles from their nearest neighbors.

The flesh of prairie-dogs is not unpalatable, and Navajo and Pueblo Indians are extremely fond of it. The Indians take advantage of heavy rains and turn the temporary rush of water down the holes to drown out the "dogs," and thus capture many of them.

It is inevitable that many popular misconceptions should grow up about such numerous and interesting animals as the prairie-dogs. In the West many people believe that the burrows go down to water. In reality, like many other rodents, these animals have acquired the ability by chemical action in the stomach to transform the starchy food into water. I have seen dog towns located on a few feet of soil resting on a waterless lava bed miles in extent and more than 100 feet thick, as shown by canyons cut through it, thus proving the impossibility of the prairie-dog-well legend.

Another popular belief is that the rattlesnakes and burrowing owls living in prairie-dog towns unite as a kind of happy family in the burrows of the dogs. The truth is that the owls live and breed in deserted dog holes, while the rattlesnakes visit the occupied holes to feed on the unfortunate occupants.

THE STRIPED GROUND SQUIRREL

(**Citellus tridecemlineatus** and its subspecies)

(*For illustration, see page 436*)

Small size and a series of thirteen narrow, well-defined stripes, or lines, marking the upperparts of the striped ground squirrel serve

to distinguish it from all its relatives. Its total length is about eleven inches and its form is nearly as slender as that of the weasel. Its brightly colored markings blend so well with the brown earth and plant stems in its haunts that when quiet it is difficult to distinguish. This protective coloration is of vital service to a small animal sought by all the diurnal birds of prey, as well as by coyotes, foxes, bobcats, badgers, skunks, weasels, and snakes.

The striped ground squirrel, also known as the "gopher" or "striped gopher," is restricted to middle North America, where it is distributed from southern Michigan and northern Indiana west to Utah, and from about latitude 55 degrees in northern Alberta south nearly to the Gulf coast of Texas. It ranges from near sea level in Texas up nearly to 10,000 feet in Colorado. Within these limits the varying climatic conditions have modified it into several geographic races, all having a close general resemblance.

Like most members of the squirrel family, the striped ground squirrels are diurnal in habits and well known wherever they occur. I first learned the ways of these odd little mammals as a boy on the prairies outside the city of Chicago, and later observed them in a high mountain valley in Arizona. In both regions they had the same habits. By preference they occupy grassy prairies, old fields, and similar situations. In many areas they are serious pests, owing to their abundance and their destructiveness to grain crops, but where the land is generally cultivated, the sheltering vegetation and their shallow burrows are destroyed by the plow, thus causing a decrease in their numbers.

The lives of the striped ground squirrels are so beset with peril that they always move abroad with watchful hesitation, pausing to listen, retreating toward their burrows at the slightest suspicious sound or movement, or rising bolt upright on their hind feet and remaining motionless as a small statue until satisfied that there is nothing to fear. They call to one another with a chirping note as well as with a shrill trilling whistle, and when alarmed by the presence of some enemy their warning call notes are heard on all sides as the alarm is passed, and all are on the alert to disappear down their burrows at the slightest suspicious movement.

When they have vanished their trilling notes are often heard from the depths of their burrows; but curiosity is one of their strongest traits, and if no disturbance follows one will almost immediately pop up its head to see the cause of the alarm. Boys, taking advantage of this habit, place an open slipping noose at the end of a long string around the entrance of the burrow, and, waiting developments, lie quietly a few yards to one side. The ensuing silence is too much for the ground squirrel to endure and soon its head appears above ground, the boy pulls the string, and the victim is dragged forth with the noose about its neck.

The entrance to the burrow of these ground squirrels is about two inches in diameter. It is usually located in the midst of grass or weedy growths, and has little or no fresh earth about it. The burrow descends for several inches almost vertically and then turns almost horizontally in a sinuous and erratic course, with numerous branches and side passages leading up to the surface. Most of these side entrances are kept plugged with soft earth. Opening off the main tunnel is a large nest chamber filled with fine dry grasses and other soft vegetable matter, and also one or more large storage chambers in which the owner lays up his garnered supplies of grain or other seeds for use during inclement weather.

These squirrels hibernate throughout their range, entering their long sleep in an excessively fat condition the last of September or in October. In the North they remain in a torpid state for six months or more.

Soon after they appear in spring they mate and the single litter of the year, containing from five to thirteen young, is born the last of May or early in June. The young are in an extremely undeveloped state at birth, being blind, hairless, and with the ears scarcely showing. They develop slowly and remain with the mother until toward fall, when, nearly grown, they scatter to care for themselves.

The striped ground squirrels are among the most carnivorous of rodents. Although they devote much time to gathering grain, seeds of various kinds, and even acorns and other nuts, which may be eaten on the spot or carried in their cheek pouches to their underground storage rooms, in addition they are known to eat insects and flesh whenever occasion offers. In fact, during seasons when such insect food as grasshoppers, caterpillars, and grubs is plentiful, these ground squirrels frequently feed mainly upon it. They are known to kill and devour mice and young birds, and when confined in a cage will sometimes kill and partly devour their own kind. When caught they fight fiercely, biting and struggling to escape. In captivity they show little of the gentleness and intelligence which are such pleasing characteristics of chipmunks and true squirrels.

THE CALIFORNIA GROUND SQUIRREL (Citellus beecheyi and its relatives)

(*For illustration, see page 437*)

Owing to its habits, the California ground squirrel is known locally as the digger-, rock-, or ground-squirrel. Its prominent ears, bushy tail, color, and form give it the general appearance of a heavy-bodied gray tree squirrel, but in reality it is a true spermophile and close kin to the marmots.

Spermophiles are nearly circumpolar in distribution, ranging through northern lands from central Europe across Bering Strait to the Great Lakes in North America. Many species exist in North America, varying greatly in form, size, and color. They occur mainly in

GOLDEN CHIPMUNK
Callospermophilus lateralis chrysodeirus

EASTERN CHIPMUNK
Tamias striatus

OREGON CHIPMUNK
Eutamias townsendi

PAINTED CHIPMUNK
Eutamias minimus pictus

the western part of the continent from the Arctic coast of Alaska to the southern end of the Mexican table-land. Some species are represented by enormous numbers and do great injury to cultivated crops. Among the larger and best known of the injurious species, the California ground squirrel, with its several geographic races, occupies most of the Pacific coast region from Oregon to Lower California. It has a broad vertical distribution, extending from the seashore to about 10,000 feet altitude on the western slope of the Sierra Nevada in California, and thrives under contrasting climatic conditions, as the humid northwest coast region and the most arid deserts of Lower California.

In California, where they are generally distributed and extremely numerous over great areas, these ground squirrels are most at home among the wild oats and scattered live oaks on the open slopes of the rocky foothills and thence up through the dense chaparral, scrub oaks, piñon pines, and junipers. Above this they populate many beautiful little valleys in colonies, as well as parts of the splendid open forests of pine and fir. Below they spread out from the foothills among the ranches in the great valleys. Wherever they occur they take heavy toll from the native forage plants, and in cultivated areas their devastations of crops place these spermophiles among the most serious of mammal pests.

They are omnivorous, eating insects and flesh on occasion, but feeding mainly on seeds, fruits, and many kinds of plants. The native vegetation in their haunts contains a wonderful variety of food plants, from humble weeds in the valleys to the lordly pines of the Sierra, but most attractive to these rodents are the rich food-bearers brought by the cultivators of the soil. The squirrels gather in great numbers about farms, and in feeding upon alfalfa, wheat, and other grains, grapes, peaches, apricots, almonds, prunes, pomegranates, and a variety of other crops, cause an annual loss to the farmers of California probably exceeding $20,000,000. So serious are their depredations that great sums have been spent in attempts to destroy them with poison. The Kern County Land Company, with vast holdings in the southern end of the San Joaquin Valley, in 1911 spent more than $40,000 for this purpose. This company estimated that the ground squirrels destroyed 20 per cent of the grain crop in great areas, and that twenty of them would destroy enough forage to support a cow through the year.

Ground squirrels by choice locate their burrows among slide rock, in crevices among cliffs, under boulders and roots of trees, in ditch or dry creek banks, or under stone walls, fences, or building, but in the parks of the high Sierra, as in the foothills and lowland valleys, they dig holes out in the open with conspicuous mounds at the entrances much like those of prairie-dogs.

Well-worn trails lead from one of their burrows to another and away to a distance through the wild oats in the foothills, or in the grain and forage crops of the valleys, and along these the animals travel when foraging or paying social visits. Whenever a large rock, stump, or other prominent object is convenient, they spend hours on the top sunning themselves and keeping a sharp lookout over their surroundings. From these lookout points when they suspect danger they utter a short, shrill, whistling note which may be heard at a long distance and which sends all their neighbors scurrying for shelter. They also have a lower chattering note, uttered about the burrow when resenting an intrusion or when otherwise displeased.

Ground squirrels are agile climbers on cliffs and among rocks as well as in fruit trees, live oaks, and other low trees, but I have never seen them far from the ground in large trees. When on the ground they run in a series of bounds like tree squirrels. The long, bushy tail is carried almost straight out behind when they scamper off in alarm, but at other times is curved and undulating, much as in the tree squirrels. They gather and manipulate food with their front paws, sitting upright on their haunches to eat or look about. On one occasion when I came to a foot-bridge over a broad irrigating ditch across which a number of ground squirrels were raiding an orchard, they did not hesitate to dash at full speed into the swiftly running water and swam quickly across to seek refuge in their holes on the far side.

Like other spermophiles, the California ground squirrels hibernate for months in the cold, snow-covered parts of their winter range, but remain active throughout the year in the warmer areas, where no snow falls. Throughout their range they gather stores of seeds, grain, and acorns and other nuts, carrying them in their cheek pouches to underground storerooms for use in bad weather. In the valleys of California they lie hidden in their burrows for days at a time during cold winter rains, but are out as soon as the sun reappears. One or more litters, each containing from six to twelve young, are born from March to late in summer, according to the locality. The young leave the nest and care for themselves when about half grown.

The swarming abundance of the California ground squirrel on foothill slopes and in fertile valley bottoms equals the congregations of prairie-dogs in their most populous districts. This abundance of small animal life supports a great variety of predatory species, as coyotes, foxes, bobcats, several kinds of hawks, and the golden eagle. Owing to its predilection for ground squirrels, the golden eagle is protected by law in California, where many of them build their nests in low live oaks only a few yards from the ground.

When house rats brought the bubonic plague to San Francisco a few years ago they also carried it across the bay and passed it on to the ground squirrels living in the foothills back of Oakland. Thence the disease spread among

these animals through parts of several surrounding counties. The United States Public Health Service and the local authorities in a vigorous campaign stopped the spread of this malady, but not until the potential ability of these rodents as plague-carriers had been well established. This fact and the wide distribution of the California and other ground squirrels over a large part of the continent should not be overlooked in connection with possible future outbreaks of the plague. Fortunately, investigation and field experiments on a large scale have shown that these spermophiles may be destroyed by poison over great areas at a relatively small cost.

THE ANTELOPE CHIPMUNK (**Ammospermophilus leucurus** and its relatives)

(*For illustration, see page 437*)

Commonly known as the antelope, or white-tailed, chipmunk, this handsome little mammal is in reality a species of spermophile, or ground squirrel. The misnomer is due, no doubt, to its small size, striped back, and sprightly ways. From the true chipmunks it may be distinguished by its heavier proportions, and from both chipmunks and all other spermophiles by its odd, upturned tail, carried closely recurved along the top of the rump. This character renders the species unmistakable at a glance and gives it an amusing air of jaunty self-confidence.

The antelope chipmunk is characteristic of the arid plains and lower mountain slopes of the Southwest from western Colorado through Utah, northern Arizona, Nevada, the southern half of California, and all of Lower California, and down the Rio Grande Valley through New Mexico to western Texas.

Within this area it occupies a wide variety of situations. It inhabits the intensely hot desert plains near sea level in Lower California, where the temperature rises to more than 125 degrees Fahrenheit in the shade and the vegetation is characterized by such picturesque forms of plant life as cactuses of many species, yuccas, fouquerias, palo verdes, ironwood, and creosote bushes; it is found also above 7,000 feet altitude on the cool plateaus and mountain slopes of Arizona and Colorado, among sage brush, greasewood, junipers, and piñon pines. It appears equally at home skipping nimbly over rocky slopes or among slide rock in arid canyons and scurrying through the brushy growth on broad sandy plains devoid of rocks.

The antelope chipmunk has the most vivacious and pleasing personality of all the numerous ground squirrels within our borders. During the many months I have camped and traveled on horseback in their haunts I have never lost interest in them. They were forever skirmishing among the bushes or dashing away down trails or over the rocks of canyon slopes, their white tails curled impudently over their backs like flags of derision at my cumbersome advance.

Their burrows are dug in a variety of places. In the open flats they enter the ground almost vertically, and often several entrances are grouped within a few yards. In some places a little mound of loose dirt is heaped up at one side of the entrance and at others there is no trace of it. Frequently, when the ground is soft, little trails lead in different directions from the entrances, and often between holes 100 yards or more apart, as though they made many social visits. The deserted burrows of other mammals are sometimes utilized to save the trouble of digging. The burrows are often under the shelter of cactuses, bushes, and great boulders or may be among crevices in the rocks.

Antelope chipmunks are extraordinarily active and continually wander far from home in search of food or in a spirit of restless inquiry. As the traveler on horseback rides slowly along he will see them racing away in front of him, sometimes climbing to the top of a bush 100 or 200 yards in advance for a better look at the wayfarer and then scuttling down and racing on again. In this way I have seen them keep ahead of me sometimes for several hundred yards instead of hiding in some hole or shelter, as they might easily do. At other times they were so unsuspicious they would permit me to pass within a few yards with slight signs of alarm. They have a chirping call, often uttered when watching from the top of a bush, and also a prolonged twittering or trilling note, diminishing toward the end.

In the higher and colder parts of their range, where snow lies long on the ground, these spermophiles hibernate for several months, but in the warmer areas they are active throughout the year. Wherever they occur they gather food and carry it to their underground storerooms in their cheek pouches. Like most ground squirrels, they eat many kinds of seeds and fruits as well as flesh and insects when occasion offers. About cultivated lands they are sometimes abundant and destructive, digging up corn or other grain as soon as it is planted and also taking toll of the ripening grain until they become a pest. In the desert they often gather about camps to pick up the grain scattered about when the horses are fed.

It is well for them that they are prolific, having one or more litters during spring and summer, with from four to twelve in each, as they have many enemies. Snakes and weasels pursue them into their burrows, while foxes, coyotes, badgers, bobcats, and many kinds of hawks, constantly reduce their numbers.

THE GOLDEN CHIPMUNK (**Callospermophilus lateralis chrysodeirus** and its relatives)

(*For illustration, see page 440*)

The golden chipmunk, or calico squirrel, as it is named in Oregon, is the most richly colored of the several geographic races of a widely known species, *Callospermophilus lateralis*, abundant among the open forests of yellow pines and firs of the western ranges, including

RED SQUIRREL
Sciurus hudsonicus

DOUGLAS SQUIRREL
Sciurus douglasi

GRAY SQUIRREL (and black phase)
Sciurus carolinensis

RUSTY FOX SQUIRREL
Sciurus niger rufiventer

FOX SQUIRREL
Sciurus niger

the Rocky Mountains, Cascades, and Sierra Nevada. Although commonly known as a chipmunk, this handsome animal is a ground squirrel, or spermophile, distinguished from all its kind by heavy stripes, resembling those of a chipmunk, along the sides of its back. From the chipmunks it may be distinguished at a glance by its thick-set and often almost obese proportions, which render its movements much slower and less graceful than they are with those nimble sprites. It occurs from northeastern British Columbia to New Mexico, southern California, and even in an area in the high Sierra Madre of southern Chihuahua, where an isolated representative occupies a limited range.

Their vertical distribution extends from a moderate elevation above the sea in Oregon to above 11,000 feet in southern California. They are common in the Yellowstone and other national parks, where their size, bright markings, and activities render them conspicuous.

Everywhere their habits resemble those of the various species of true chipmunks with which they associate. They live in burrows, which they dig under the shelter of logs, rocks, stumps, roots of trees, or even in open ground, as well as in the ready-made shelter of rock slides, with conies, at timberline. Their burrows at times have several entrances within a small area. Often they occupy the burrows of other animals, including pocket gophers. They excavate burrows under cabins or barns in clearings, and abandoned mining camps or old sawmill sites frequently abound with them. Nests and storage chambers are excavated off the passageways. The nests are usually made of leaves and other soft vegetable material, but in the sheep country wool, which they find in scattered tufts, is often used.

A camping party in their haunts is certain to attract them, and, as about barns, it is necessary to keep a watchful eye on them to prevent their robbing grain sacks or other supplies. When they once locate an accessible supply of grain their industry is remarkable. I have seen a dozen or more working throughout the day, making continuous hurried trips, with loaded cheek pouches, to their dens, sometimes two hundred yards away. On approach of autumn they become continually active, gathering their winter supplies.

The length of their hibernation varies with the severity of the climate, but is rarely under five months. It is said to run through seven months on the higher mountains of southern California. They usually go into winter quarters in September or early in October, but occasionally one may be seen out as late as December. At this time they have become so fat that their movements are very sluggish. One kept as a pet for eleven years at Klamath Falls, Oregon, is reported to have hibernated regularly each winter. In Montana they retire to their dens in September and come out in March. They mate soon after they appear in spring and the young, four to seven in number, are half grown the last of May.

Like true chipmunks, these spermophiles are fond of weedy clearings or other openings in the forest, where stumps, logs, rocks, and old fences offer plentiful shelter and many elevated vantage points where they may sit by the hour watching the doings of their small world. They have a sharp whistling or chirping call note, usually uttered as a warning cry, but sometimes as a social call. They do not like gloomy or stormy weather and generally lie hidden at such times, but on sunny days are so actively engaged in foraging, running along the tops of logs, or perching on the tops of stumps and large rocks that they add greatly to the pleasant animation of the forests where they live. When running they usually carry the tail elevated like a chipmunk.

They sun themselves for hours on elevated points, sometimes lying quiescent and again sitting bolt upright, but always watchful and ready to disappear at the slightest alarm. This watchfulness is necessary, for their enemies are abroad at all hours. They are the prey of bobcats, foxes, coyotes, weasels, snakes, and hawks.

The golden chipmunk and its related subspecies are omnivorous feeders. They show a strong predilection for bacon when looting camp stores and eat any kind of meat with avidity. Young birds and birds' eggs are devoured whenever found, as are also grasshoppers, beetles, flies, larvæ, and many other insects. The number of kinds of seeds eaten is almost endless and includes chinquapin and pine nuts, rhus, alfileria, violet, lupine, ceanothus, and others. They also eat roses and other flowers, green leaves, wild currants, gooseberries and other fruit, and small tuberous roots. They often climb bushes and low trees, at least 30 feet from the ground, after nuts and berries. The capacity of their cheek pouches is shown by one instance, when one animal was loaded with 750 serviceberry seeds. The pouches of another contained 360 grains of barley, another 357 of oats. Bold and persistent camp robbers, their depredations cover all articles of food, including bread and cake, and they sometimes do considerable injury to small mountain grain fields.

I had the pleasure of living in the mountains of New Mexico and Arizona for several years where these attractive ground squirrels were numerous, and vividly remember them as among the most interesting of the woodland folk. Their friendliness about forest cabins is notable and with a little encouragement they become extremely confiding and amusing visitors.

The young are playful, pursuing one another in apparent games of "tag" over rocks, stumps, and logs. When partly grown they have all the heedlessness of youth and on one occasion an observer saw the mother repeatedly push the young back into crevices in a rock slide with her front feet, as they persisted in trying to come out to look at the strange intruder in their haunts.

THE EASTERN CHIPMUNK (Tamias striatus and its relatives)

(*For illustration, see page 440*)

The chipmunks are close relatives of the tree squirrels, but live mainly on the ground, are provided with cheek pouches for carrying food to their hidden stores, and have many ways similar to those of the spermophiles, or ground squirrels. They are nearly circumpolar in distribution, ranging through eastern Europe and northern Asia as well as from the Atlantic to the Pacific in North America. On this continent they are far more numerous in species and individuals than in the Old World, and their center of abundance appears to lie in the mountainous western half of the United States. Their extreme range extends from near the Arctic Circle in Canada to Durango and Middle Lower California, Mexico.

As a group the chipmunks are widely known for their grace, beauty of coloration, and sprightly ways. Among the handsomest and most familiar is the common chipmunk of Canada and the United States east of the Great Plains. Within this area it is divided into several geographic races, of which the best known is the brightly colored animal occupying all the wooded region from the Great Lakes to Nova Scotia and New England, which is the subject of the accompanying illustration. Its vertical distribution extends from sea level to the summit of Mount Washington, where it may be seen on pleasant summer days.

The eastern chipmunks, like most of their kind, belong to the forest and its immediate environment. Favorite haunts are rocky ledges covered with vines and brush, half-cleared land, the brushy borders of old pasture fences, stone walls, and similar situations. In early days they were so plentiful in places that they made serious inroads on the scanty crops of the settlers, and bounties were offered for their destruction.

No one who visits the woods of the eastern States or Canada can fail to observe with pleasure the alert, attractive ways of these little squirrel-like animals. They are everywhere, including the vicinity of summer camps in the forest, and, if encouraged, prove most attractive and friendly neighbors. To such small beasts the world is peopled with enemies against which the only safeguard is eternal watchfulness. This accounts for the hesitating advances and retreats so characteristic of these chipmunks, which at the first sudden movement of any suspicious object, or loud noise, disappear like a flash. They soon learn to recognize a friend and in many places come regularly into camp buildings to receive food. I doubt, however, if they ever become quite so friendly as some squirrels under similar conditions.

Like most of the squirrel tribe, they are endowed with much curiosity, and at the appearance of anything unusual, but not too alarming, they seek some safe vantage point from which to peer at it with every sign of interest. They are extremely timid and wary, however, and if doubtful move by little cautious runs, stopping to sit up and look about, often mounting a stump, log, or a side of a tree trunk for the purpose, the tail all the time moving with slow undulations. If alarmed they dash away to the nearest shelter, the tail held nearly or quite erect and sometimes quivering excitedly. When running to shelter they often utter chattering cries of alarm. Their principal enemies are cats, weasels, martens, foxes, snakes, birds of prey, and the untamed small boy with his dog. Weasels, the supreme terror of their existence, follow them to the depths of their burrows and kill them ruthlessly.

These chipmunks are sociable and playful, often pursuing one another, first one and then the other being the pursuer, as though in a game. They race along fence tops and old logs and up stumps and even the lower parts of tree trunks. Lovers of bright, sunny weather, they usually remain hidden in their burrows during stormy days. If they venture out at such times they are quiet and show none of the mercurial liveliness which characterizes them when the weather is pleasant.

Their food includes a great variety of cultivated and wild plants, as wheat, buckwheat, corn, grass seed, ragweed seed, hazelnuts, acorns, beechnuts, strawberries, blueberries, wintergreen berries, mushrooms, and many others. In addition they eat May beetles and other insects and insect larvæ, snails, occasional frogs, salamanders, small snakes, and many young birds and eggs.

At all seasons they fill their cheek pouches with food to be carried away to their dens, but toward the end of summer or early fall they work industriously laying up stores of seeds and nuts. Sometimes these stores, hidden in chambers excavated for the purpose or in hollow logs and similar places, contain several quarts of beechnuts or other nuts or seeds. Small quantites of such food are hidden here and there under the leaves or in shallow pits in the ground. Store-rooms in one burrow contained a peck of chestnuts, cherry pits, and dogwood berries, and another had a half bushel of hickory nuts.

While at a summer camp I once saw one of these chipmunks give an exhibition of the exquisitely keen power of scent which must be necessary to recover scattered stores. The chipmunk had been coming repeatedly down a wooded slope in full view for twenty-five yards or more to the floor of the porch for food supplied by the campers. While it was absent carrying food to its burrow I placed a few nut meats on the flat top of a stump about fifteen feet to one side of the porch and farther away than the point where the chipmunk was being fed bread crumbs. On its return several minutes later, instead of going as usual to the porch, it ran directly to the stump, climbed up it, and promptly made off with the nuts, which it had evidently located from afar. They sometimes climb beeches and other trees to gather nuts even to a height of fifty or sixty

ABERT SQUIRREL
Sciurus aberti

KAIBAB SQUIRREL
Sciurus kaibabensis

FLYING SQUIRREL
Glaucomys volans

BLACK-FOOTED FERRET
Mustela nigripes

feet, and are commonly seen on low limbs and in bushes.

The entrances to the burrows are usually under logs, roots, or rocks, or the den may be in a hollow log, stump or base of a tree, or even under a cabin in the woods. The burrows in the ground are commonly a series of tunnels some yards in length, with an oval nest and storage chamber two or three feet underground, and with branches from the main passageway. The nest chamber, a foot or more in diameter, is filled with fragments of dry leaves and other soft vegetable material. One chamber is usually used for sanitary purposes. The used entrance hole is commonly without a sign of dug earth about it, the loose soil from the burrow and its chambers apparently having been thrown out at another opening, which appears to be used for this purpose only and is kept plugged with earth.

Throughout most of the northern half of its range these chipmunks usually hibernate from some time in October until March. Their hibernation is far less profound than that of the woodchuck and they not infrequently appear above ground during periods of mild weather, even in midwinter. The hibernating period is shorter in the southern part of the range.

They vary much in numbers from year to year and at times appear to increase suddenly in localities where food is plentiful, indicating a probable food migration. The young, numbering from four to six in a litter, are born at varying times between the last of April and late summer, indicating the possibility of more than one litter a season.

The most characteristic note of this chipmunk is a throaty *chuck, chuck,* which is ordinarily used as a call note, but which in spring is uttered many times in rapid succession to express the seasonal feeling of joy and well being, thus taking on the character of a song. Such joyful notes may be heard on every hand in places where the little songsters are numerous. In addition, they have a high-pitched, chirping note and a small churring whistle when much alarmed.

THE OREGON CHIPMUNK (Eutamias townsendi and its relatives)

(*For illustration, see page 441*)

The resident species of birds and mammals in the humid coastal region of Oregon, Washington, and southern British Columbia are strikingly characterized by their darker and browner colors in comparison with closely related species in more arid districts.

The Oregon chipmunk is one of the common species showing marked response to these local climatic conditions and is the darkest of all the many species of chipmunks in the Western States. This chipmunk is one of several geographic races into which the species is divided by changing environment. The species, as a whole, ranges along the west coast from British Columbia to Lower California, and the races at the extremes of the line differ much in color.

As befits a habitant of the humid forested region, the Oregon chipmunk is robustly built and distinctly larger than the other chipmunks of the Western States. It is common and generally distributed throughout this region, occurring from among the drift logs along the ocean beach to above timberline on the Cascade Mountains. Within these limits it frequents almost every variety of situation. It occurs in the midst of gloomy forests of giant spruces, cedars, and firs, but is particularly fond of old fences and brush patches on the borders of farm clearings in the valleys as well as the vicinity of rocky ledges, brush piles, and fallen timber, where the low thickets offer a variety of food-bearing plants and ready shelter.

On the mountains it is most numerous about rock slides and "burns" or other openings in the forest. Several pairs usually haunt the vicinity of old sawmills and of mountain cabins. Like others of their kind, they are alert and vivacious, varying in mood from day to day, but always interesting. At times they are excessively shy and retiring, and a person might spend a day in their haunts without seeing or hearing one, although it is safe to say that the intruder had been seen and every foot of his progress noted by the chipmunks. On another day, perhaps because the sun shines more brightly and nature is in a happier mood, the animals appear on all sides. Their slowly repeated sociable *chuck, chuck,* is heard from the depths of the brushy covert as well as from the tops of stumps, logs, rocks, or other lookout points where they sit to view their surroundings. If alarmed they utter a sharp, birdlike chirping note as they vanish in the nearest shelter. As one moves about in their haunts he may now and then see one appear for a moment above the undergrowth in a tall bush, on top of a stump, and sometimes even mounting a few yards up a tree trunk to observe the cause of the disturbance, only to vanish quickly.

They are always skirmishing for food, and carrying it in their cheek pouches to hidden stores. On the approach of winter this activity becomes very marked. A surprising variety of fruits and seeds are eaten and stored, among them the salmonberry, red elderberry, black-capped raspberry, thimble berry, blackberry, blueberry, gooseberry, thistle seed, dogwood seed, hazelnuts, acorns, and others. They have favorite feeding places, such as the top of a stone or stump or the shelter of a log where they carry nuts or other seeds. These places are always marked by little piles of empty shells or chaff from seeds. About ranches they raid grain fields and other crops, sometimes in numbers sufficient to do considerable damage.

In sheltered spots they make underground burrows with nest chamber and store-rooms excavated along the passages. They usually retire to these dens to hibernate during the last of September or first of October, and appear again about March or April, often long before the snow disappears. During fall and early

winter they are sometimes seen running about over newly fallen snow. One which was dug from its winter quarters in British Columbia the last of November would move about slowly and sleepily if teased, but when left undisturbed would curl up and go to sleep again. This indicates the difference between the light and often broken hibernation of chipmunks and the deep lethargy which possesses ground squirrels in the North at this time. Toward the southern end of their ranges neither chipmunk nor ground squirrel hibernates. They mate soon after they awake from their winter sleep, and the young, two to five or six in number, are born from April to June. Whether more than one litter is born during a season, is, like many other details concerning the lives of these attractive animals, still to be learned.

THE PAINTED CHIPMUNK (Eutamias minimus pictus and its relatives)

(*For illustration, see page 441*)

The preceding sketch tells how the Oregon chipmunk, living under a cool, humid climate, in a region of great forests, has responded to its environment by developing dark colors and a robust physique. The painted chipmunk of the Great Basin has given an equally perfect response to entirely different conditions. It is one of the geographic races of a species peculiar to the sagebrush-covered plains and hills from the Dakotas across the Rocky Mountains and the Great Basin region to the east slope of the Cascades and the Sierra Nevada. Its home is on treeless plains, in a climate characterized by brilliant sunshine and clear, dry air. In this environment the painted chipmunk has developed a smaller and slenderer body than the Oregon species, and strikingly paler colors.

These differences in physique are accompanied by equal differences in mental and physical expression. These little animals are exceedingly alert and agile, darting through dense growths of bushes with all the easy grace of weasels. When running they hold the tail stiffly erect. When alarmed they utter a shrill chippering cry, especially when darting into shelter. They also have a chucking call, uttered at intervals, which may be used merely as a note of sociability or to put their neighbors on the alert.

Although one of the most distinctive animals of the sagebrush plains, this chipmunk also ranges into the borders of open forests on the mountain sides. It is most numerous on flats and foothill slopes among heavy growths of sage and rabbit brush. When its territory is invaded by settlers it does not hesitate to gather about the borders of fields and even to raid barns in search of grain and other food. Its burrows are dug under large sagebrush and other bushes and under rocks and similar shelter.

As with others of their kind, painted chipmunks habitually gather seeds of many plants and carry them in their cheek pouches to their underground dens. In addition to seeds and green vegetation, they eat any fruits growing in their haunts, and also many insects, especially grasshoppers and larvæ. In one locality in Nevada during June and July more than half their food consisted of a web worm and its chrysalids with which the sage bushes swarmed. The chipmunks climbed into the bushes and pulled the larvæ from the webs. As half the bushes were infested, the work of the many chipmunks had a material effect in reducing the numbers of this pest. The vegetable food eaten includes the seeds of *Ribes, Kuntzia, Sarcobatus,* pigweed, and many other weeds, serviceberry, various grasses, oats, wheat, and the seeds of small cactuses. They regularly climb into the tops of large sage and other bushes for their seeds and the ground beneath is often covered with the small sections of twigs cut by them. They climb readily and often travel from bush to bush through tall thickets like squirrels in tree-tops. On warm mornings after frosty nights they may be seen in the tops of the bushes basking in the sun.

Throughout most of their range they begin hibernation in September or October, and reappear early in spring. The young appear a month or more later, and litters containing from two to six may be born throughout the summer, indicating the possibility that several litters may be born to the same pair in a season.

So alert and shy are they that even a person in their haunts day after day will see but few of them. Their hearing is extremely acute, and even at a great distance the footsteps of an intruder sets them all on the alert. On every side they run swiftly to cover before the observer has opportunity to see them. In such places a large setting of baited traps will reveal their presence in surprising numbers. In one locality, during a brief visit, traps set among the brush for other small mammals yielded more than forty chipmunks.

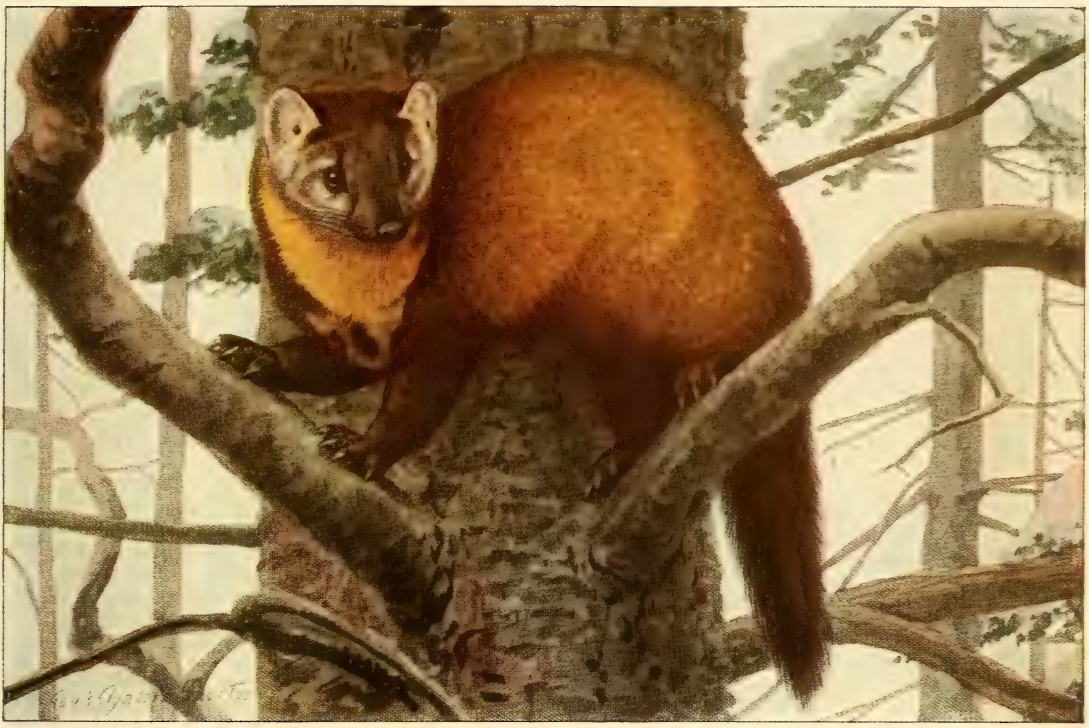
On stormy and cloudy days, especially if the weather is cool, painted chipmunks remain in their dens, but on mild sunny days they frisk about with amazingly quick darting movements. A horseman riding along a road leading through a sagebrush flat will frequently see them racing across the road often several hundred yards away, the sound of the horse's footfalls having alarmed the chipmunks over a wide area. Here and there one may be seen climbing hastily to the top of a tall bush to take a look at the cause of alarm before finally seeking concealment. When pursued among the bushes they often run considerable distances before taking refuge in a burrow. When hard pressed they will enter the first opening encountered, but if it is not its own home the fugitive soon comes out and scampers away, apparently fearful of the return of the owner or perhaps owing to his presence.

Apparently, as in the case of many other desert mammals, the painted chipmunk, with its related races, is able to subsist without drink-

Winter Summer

LEAST WEASEL
Mustela rixosa

LARGE WEASEL, or STOAT (Winter and Summer)
Mustela arcticus



MARTEN, or AMERICAN SABLE
Martes americana

AMERICAN MINK
Mustela vison

ing, since it is often seen far out on arid plains many miles from the nearest water.

As with all its kind, the world of the painted chipmunk is filled with imminent peril of sudden death. Overhead, gliding on silent pinions, are hawks of several species, while on the ground snakes, weasels, badgers, bobcats, foxes, and coyotes are ever searching for them as prey.

THE RED SQUIRREL (Sciurus hudsonicus and its relatives)

(*For illustration, see page 444*)

Every one who has visited the forests of Canada and northeastern United States knows the vivacious, rollicking, and frequently impudent red squirrel. This entertaining little beast, known also as the pine squirrel and chickaree, has little of that woodland shyness so characteristic of most forest animals. It often searches out the human visitor to its haunts and from a low branch or tree trunk sputters, barks, and scolds the intruder, working itself into a frenzy of excitement. This habit, combined with the rusty red color and small size of the animal, about half that of the gray squirrel, renders its identity unmistakable. It has distinct winter and summer coats, but in both the rusty red prevails. The winter dress is distinguished, however, by small tufts on the ears.

The red squirrel, with its related small species, occupying most of the wooded parts of North America north of Mexico, forms a strongly characterized group, with no near kin among the squirrels of the Old World. In its geographic races it ranges through the forests of all Alaska and Canada and south to Idaho, Wyoming, the Dakotas, Wisconsin, northern Indiana, all the Northeastern States to the District of Columbia, and along the Alleghenies to South Carolina. Owing to its small size, this animal, like the chipmunk, is considered too small for game, although occasionally hunted for sport. As a consequence its increase or decrease is usually governed by the available food supply, although man interferes locally when it becomes too destructive.

This squirrel shows a strong preference for coniferous forests, whether of hemlock, spruce, fir, or pine, but may be common in woods where conifers are few and widely scattered. Although usually diurnal and busily occupied from sunrise until sunset, it sometimes continues its activities during moonlight nights, especially when nuts are ripe and it is time to gather winter stores. During warm, pleasant days in spring and fall, when the nights are cool, it often lies at full length along the tops of large branches during the middle of the day, basking in the grateful warmth of the sun.

The nests, which are located in a variety of situations, are made of twigs, leaves, or moss, and lined with fibrous bark and other soft material. Some are in knot-holes or other hollows in trees, others may be built outside on limbs near the trunk, and still others are in burrows made in the ground under roots, stumps, logs, brush heaps, or other cover offering secure refuge. Apparently several litters of young, containing from four to six, are born each season, as they have been found from April to September.

They do not hibernate, but are active throughout the year, except during some of the coldest and most inclement weather. To provide against the season of scarcity, they accumulate at the base of a tree, under the shelter of a log, or other cover, great stores of pine, spruce, or other cones, sometimes in heaps containing from six to ten bushels. They also hide scattered cones here and there and place stores of beechnuts, corn, and other seeds in hollows or underground store-rooms. They are fond of edible mushrooms and sometimes lay up half a bushel of them among the branches of trees or bushes to dry for winter use. In the western mountains their great stores of pine cones are often robbed by seed-gatherers for forestry nurseries. In winter they tunnel through the snow to their hidden stores and sometimes continue the tunnels from one store to another.

Each squirrel makes its home for a long period in or about a certain tree. There he carries his cones to extract the seeds, and on the ground beneath it the accumulation of fallen scales and centers of cones sometimes amounts to fifteen or twenty bushels. In addition to the seeds of the various conifers, red squirrels eat many kinds of fruits and seeds; they also raid cornfields and orchards and even make nests in barns and woodsheds to be near the food supply which some farmer's industry has collected.

Red squirrels have the interesting habit of voluntarily swimming streams and lakes, including such bodies of water as Lake George and even the broadest parts of Lake Champlain. When they thus cross the water and make their migrations, there is little doubt that they are usually in search of a better feeding ground.

The red squirrels and related species have the greatest variety of notes possessed by any of the American members of the squirrel family. In addition to the barking, scolding, chattering notes already mentioned, they have a real song, which is one of the most attractive of woodland notes. It is a long-drawn series of musical rolling or churring notes, varied at times by cadences and having a ventriloquial quality rendering it difficult to locate. These notes never fail to awaken pleasurable emotions and to recall to me my early boyhood in the Adirondacks, where the spring songs of the chickarees were among the first calls which awakened me to the marvelous beauties of nature.

The worst trait of the red squirrel and one which largely overbalances all his many attractive qualities is his thoroughly proved habit of eating the eggs and young of small birds. During the breeding season he spends a large part of his time in predatory nest hunting, and the number of useful and beautiful birds he

thus destroys must be almost incalculable. The number of red squirrels is very great over a continental area, and one close observer believes each squirrel destroys 200 birds a season. Practically all species of northern warblers, vireos, thrushes, chickadees, nuthatches, and others are numbered among their victims. The notable scarcity of birds in northern forests may be largely due to these handsome but vicious marauders.

In the fur country these squirrels are much disliked by the trappers for their constant interference with meat-baited traps. Many fall victims to their carnivorous desires, but their places are soon taken by others.

The energy and unfailing variety in the performances of red squirrels always keep the attention of their human neighbors. Among other interesting activities, their pursuit of one another up and down and around the trunks of trees, over the ground, along logs, back and forth in the most reckless abandon, is most entertaining to watch. These pursuits among the young are playful and harmless, but among the males in spring are of the most deadly character. I have seen the victim go up and down tree after tree, shrieking in fear and agony and leaving a trail of blood on the snow as he tried to escape his truculent pursuer.

Such scenes as this, combined with our knowledge of its bird-killing habits, appear belied by the exquisite grace and beauty of this squirrel as it sits on a branch and sends its musical cadences trilling through the primeval forest. So confirmed are red squirrels in the destruction of bird life, however, they should not be permitted to become very numerous anywhere and it may eventually become necessary to outlaw them wherever found.

THE DOUGLAS SQUIRREL (Sciurus douglasi and its relatives)

(*For illustration, see page 444*)

In all details of size, form, notes, and habits the Douglas squirrel gives testimony to its descent from the same ancestral stock as the common red squirrel (*Sciurus hudsonicus*). The typical Douglas squirrel, represented in the accompanying illustration, is one of several geographic races of a species which ranges from the Cascades and Sierra Nevada to the Pacific, and from British Columbia south to the San Pedro Martir Mountains of Lower California. The home of the Douglas squirrel is amid the wonderful coniferous forests of western Oregon, Washington, and southern British Columbia. As in other mammals of this extremely humid region, the colors of its upperparts are dark brown, in strong contrast to the much paler and grayer colors of the closely related subspecies living in the clearer and more arid climate of the Sierra Nevada in California. These squirrels are known locally by a variety of common names, including pine squirrel, redwood squirrel, and "drummer."

Although usually not quite so noisy and self-assertive as the irrepressible little red blusterer of eastern forests, the Douglas squirrel is also notable for its rollicking, chattering character and sometimes cannot be outdone in its amusing displays of aggressive impudence. When the animals are numerous the air at times resounds with their call notes or songs, one answering the other, now near and now far, until the somber depths of the mighty forest seems peopled with a multitude of these joyous furry sprites. Their song, resembling that of the red squirrel, is a rapid trilling or bubbling series of notes, long drawn out and sometimes varied by cadences. It is so musical that it seems more like the song of some strange bird than of a mammal. When these squirrels are not common they are much less given to song and seem subdued and shy, as though impressed by the vast loneliness of their deep forest haunts.

At mating time, early in spring, they are especially noisy, and again in summer when the first litter of young are out trying their youthful pipes in expression of their cheerful well being. They frequently come down on a low branch or on the trunk of a tree and chatter, bark, and scold at man, dog, or other intruder, now rushing up and down, or making little dashes around the tree trunk, their necks outstretched and tails flirting with a great show of anger and contempt highly entertaining to see. They are restlessly active at all seasons of the year and habitually chase one another through the forest with an appearance of rollicking fun which may many times be in more deadly earnest than appears to the casual observer.

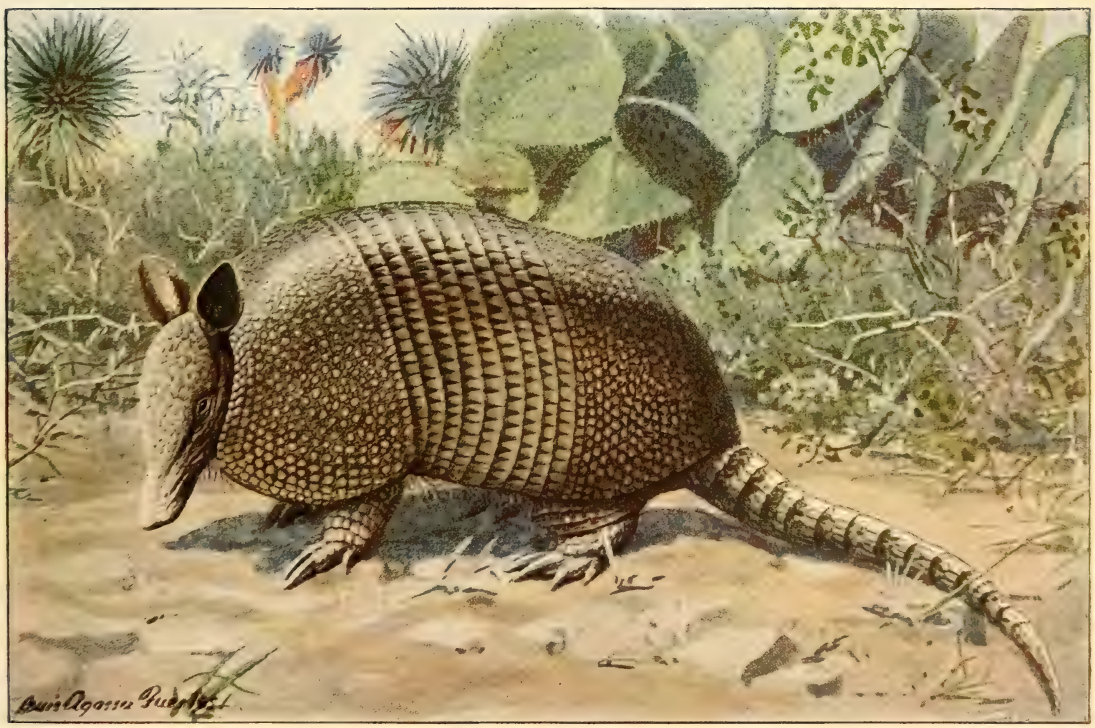
In winter their tracks in the snow lead from tree to tree, along the tops of logs and fences, and in all directions to hidden stores of food, which they appear to be able to locate with unerring certainty under the snow. An adventurous spirit leads them to race away from the forest, along fence-tops, to pay visits to ranch buildings and even to villages and small towns. Like their eastern relative, the Douglas squirrels are omnivorous, feeding on the seeds of all the conifers in their range, including spruces, firs, pines, and redwoods, and also upon acorns, and a great variety of other seeds, fruits, and mushrooms, insects, birds' eggs, young birds, and any other meat they can find. Owing to their habit of interfering with meat-baited traps, they are a nuisance to trappers. They frequently visit orchards and carry off apples and pears, from which they extract the seeds. They have been seen also to visit the wounds made on a willow trunk by sapsuckers to drink the flowing sap. Their feet and the fur about their mouths are often much gummed with pitch from working on pine cones.

In many places the soft, moist earth in the woods is riddled with little pits dug by these squirrels apparently when they are after larvæ or perhaps edible roots. Throughout the summer, but especially during the last half of the season, and in autumn Douglas squirrels work with persistent energy to amass great stores

LITTLE SPOTTED SKUNK
Spilogale putorius

COMMON SKUNK
Mephitis mephitis

HOG-NOSED SKUNK
Conepatus mesoleucus



NINE-BANDED ARMADILLO
Dasypus novemcincta

of seed-bearing cones, which they heap, sometimes bushels of them, about the bases of trees, stumps, and the upturned roots of fallen trees or under other shelter. Cones are also buried here and there in the loose leaves and humus. In winter many holes in the snow with piles of cone scales at the entrances show where the owners have dug down to their stores.

Some of their nests are constructed in hollow trees, many others on branches near their junction with the trunks, and still others in underground dens under roots, logs, or stumps. In winter when alarmed these squirrels sometimes race down the tree trunks and take refuge in holes leading through the snow to their food caches and underground burrows. The nests built in tree-tops are usually rather bulky, measuring a foot or more in diameter, and are made of small twigs, dry leaves, moss, grass, and fibrous bark. They are commonly lined with such soft material as feathers and fur. The young, numbering three to seven at a litter, are born at any time between April and October.

The extraordinary intelligence and sense of prevision possessed by squirrels of this group is well illustrated by certain local food migrations. These have been observed in eastern Oregon in years when the cone crop has failed and nothing was available to lay up for winter. Under such conditions to remain in the mountain forests would mean death by starvation before winter had fairly begun. In 1910 and 1913 failure of the cone crop occurred in eastern Oregon and these squirrels promptly left the mountain forests in September and descended along creek courses to the open sagebrush plains as much as seven or more miles from the border of their ordinary haunts. In this open country they wintered successfully, raiding the farmers' grain bins, root cellars, and other stores, and otherwise showing their supreme fitness to survive in the struggle for existence. With the coming again of summer they promptly returned to their abandoned homes in the pines. It appears to be one of the marvels of animal intelligence that under such circumstances as those named above the entire body of the squirrels on the mountains should have known what to do, especially as a great percentage of their number could never have had any previous experience as a guide.

THE GRAY SQUIRREL (Sciurus carolinensis and its relatives)

(*For illustration, see page 445*)

The gray squirrel is so well known to everyone in the Eastern States that it scarcely needs an introduction. Many who have not seen it in its native haunts are familiar with it as a graceful and charming resident of parks in many cities. It is about twice as large as the red squirrel and intermediate in size between that species and the fox squirrel. Although sharing some of the range of both the species named, the color of the gray squirrel at once distinguishes it.

The gray squirrel is a North American species with no near relative in the Old World; on the Pacific coast, in the mountains of the Southwest, and in Mexico are other squirrels having much the same gray-colored body, but with no close relationship to it. Its range covers the deciduous forests of the Eastern States and southern Canada from Nova Scotia to Florida, and westward to the border of the treeless Great Plains. Wherever they occur these squirrels are an attractive element in the woodland life, their barking and chattering, their graceful forms, and their activity adding greatly to the cheerful animation of the forest. They are far less vociferous than red squirrels, but their notes are varied and serve to express a variety of meanings.

During the early settlement of the country west of the States bordering the coast, gray squirrels existed in great numbers and often made ruinous inroads on the pioneer corn and wheat fields. In 1749 they invaded Pennsylvania in such hosts that a bounty of three pence each was put on their scalps. Eight thousand pounds sterling was paid on this account, which involved the killing of 640,000 squirrels. In 1808 a law in force in Ohio required that each free white male deliver 100 squirrel scalps a year or pay $3 in cash. Records of the ravages of these squirrels in corn fields are extant also from Kentucky, Missouri, and other States.

Enormous migrations of gray squirrels from one part of the country to another occurred in those days, caused apparently by the failure of food supplies in the deserted areas. Some impulse to move in one general direction at the same time appeared to affect the squirrels and they swarmed across country in amazing numbers, carrying devastation to any farms crossed on the way. When engaged in such movements they appeared indifferent to obstacles and without hesitation swam lakes and streams even as large as the Hudson and the Ohio. Amusing legends grew up concerning these migrations, one of which avers that when the squirrels arrived on a river bank each dragged a large chip or piece of bark into the water and mounting it raised its bushy tail in the breeze and was wafted safely to the other shore! As a fact, many were drowned in crossing large streams and others arrived exhausted from their exertions.

The gray and fox squirrels were favorite targets for pioneer marksmen. The early chronicles tell of the ability of Daniel Boone and other riflemen to "bark" a squirrel, which meant so to cut the bark of the branch on which the squirrel sat as to bring it to the ground stunned without hitting the animal. With the clearing away of the forests, the general occupation of the country, and the decrease of larger animals, gray squirrels have been deprived of most of their haunts and have become such desirable game that they have decreased to a point requiring stringent legal protection to save them from extermination.

Gray squirrels are more thoroughly arboreal than red squirrels and make their nests either

in hollow trunks or build them in the tops of trees. These outside nests are common and much like a crow's nest in appearance except that they are generally more bulky and show more dead leaves. They are built on a foundation of small sticks with a rounded top of leaves, and are lined with shreds of bark, moss, and similar soft material. In the extreme northern part of their range they live mainly in hollow trees, but farther south many winter in outside nests. During severe cold and in stormy weather they remain hidden, sometimes for days at a time.

They have two litters of four to six young a year, the first usually being born in March or April. The old squirrel is a devoted mother and if the nest is disturbed she will at once carry the young to some safer retreat.

In many parts of their range black, or melanistic, individuals are born in litters otherwise of the ordinary gray color. In some districts the number of the black squirrels equals or exceeds the gray ones.

Gray squirrels range through such a variety of climatic conditions that their food varies greatly. They eat practically all available nuts, including acorns, chestnuts, beechnuts, hickorynuts, and pecans, besides numberless seeds, many small fruits, and mushrooms. They raid fields for corn and wheat, and steal apples, pears, and quinces from orchards to eat the seeds. Like most other small rodents, they are fond of larvæ and insects and also destroy many birds' eggs and young birds. They are far less serious offenders, however, in destroying birds than the red squirrel.

On the approach of winter they lay up stores of seeds and nuts in holes in trees and in little hiding places on the ground. Many nuts are hidden away singly. In the public parks of Washington, where many gray squirrels exist, I have repeatedly seen them dig a little pit two or three inches deep, then push a nut well down it, cover it with earth, which they press firmly in place with the front feet, and then pull loose grass over the spot. One squirrel will have many such hidden nuts, and with nothing to mark the location it appears impossible that they could be recovered. That the squirrels knew what they were doing I have had repeated evidence in winter, even with several inches of snow on the ground, when they have been seen sniffing along the top of the snow, suddenly stop, dig down and unearth a nut with a precision that demonstrates the marvelous delicacy of their sense of smell. Although mainly diurnal, they are sometimes abroad on moonlight nights, especially when gathering stores of food for winter.

Wherever they are, these squirrels are extremely graceful, moving along the ground by curving bounds, the long fluffy tail undulating as they go, or running through the tree-tops, leaping from branch to branch with an ease and certainty beautiful to see. When pressed they make amazing leaps from tree to tree or even from a high tree-top to the ground without injury. They are extremely cunning at concealing themselves by lying flat on top of branches or by gliding around tree trunks, keeping them interposed between themselves and the pursuer.

Gray squirrels are so responsive to protection that they may continue to grace our remaining forests if we properly guard them. In addition to their beauty, they are interesting game animals which should continue to afford a moderate amount of sport—sufficient to prevent them from becoming overabundant and destructive. Now introduced in many city parks throughout the United States and in parts of England, including London, their ready acceptance of people as friends renders them charming animals in such places; but natural food is so scarce under these artificial conditions that care must be taken to feed them at all seasons, especially in winter.

THE FOX SQUIRREL (Sciurus niger and its relatives)

(*For illustration, see page 445*)

THE RUSTY FOX SQUIRREL (Sciurus niger rufiventer)

(*For illustration, see page 445*)

Three species of tree squirrels inhabit the varied forests of eastern North America, each having its marked individuality expressed in color, size, and habits. All occupy a wide territory with varying climatic conditions, to which each species has responded by becoming modified into a series of geographic races, or subspecies. The red and the gray squirrels have already been described and it remains to give an account of the largest and in some respects the most remarkable of the three, the fox squirrel.

No other species of North American mammal can show such an extraordinary contrast in color among its subspecies as that between the rusty yellowish animal of the Ohio and upper Mississippi Valleys, and the handsome blackish one of the Southeastern States, both of which are pictured in the accompanying illustration.

The distribution of the fox squirrel is limited to the forested parts of the Eastern States. There it ranges from the Atlantic coast to the border of the Great Plains, and from southern New York and the upper Mississippi Valley southward to Florida, the Gulf coast, and across the lower Rio Grande into extreme northeastern Mexico.

Variations in the character of the haunts of the different subspecies of this squirrel almost equal their differences in color. In the upper Mississippi and Ohio Valleys the rusty-colored race frequents the upland woods, where the nut-bearing hickory trees characterize the forests. In the South the dark-colored squirrels have more varied homes, either amid the live oaks draped in long Spanish moss, in the mysterious cypress forests of the swamps, or out in the uplands among the southern pines.

RING-TAILED CAT

Bassariscus astutus

OREGON MOLE
Scapanus townsendi

STAR-NOSED MOLE
Condylura cristata

In early days fox squirrels were plentiful, but never equaled the numbers of the gray squirrel. They appear always to have been more closely attached to their own district, for we have no records of the great migrations so notable in the other species.

Fox squirrels are not only distinguished from gray squirrels by their color, but are also nearly twice their size, commonly attaining a weight of two and sometimes nearly three pounds. They are the strongest and most heavily proportioned of all American squirrels. A deliberation of movement going with heaviness of body is in marked contrast to the graceful agility of most other tree squirrels. On the ground they walk with a curiously awkward, waddling gait, and even when hard pressed climb trees with none of the dashing quickness shown by other species. They often move about on the ground by a series of bounds, and at such times, with broad, feathery tails undulating in the air, present a most graceful and attractive sight.

Fox and gray squirrels occupy the same districts throughout most of their ranges, but often become so segregated locally that the grays may be found almost exclusively along bottom-lands and the fox squirrels on the higher ridges, but there is no hard and fast separation of haunts and the two forms usually share the same woodlands.

Much time is spent by fox squirrels on the ground searching for food. When danger approaches, in place of promptly taking refuge in a tree, as is a common habit with most tree squirrels, they retreat along the ground, mounting a stump or log now and then, to look back at a suspected intruder, whose footsteps they can hear at a long distance. If the hunter is without a dog they may run away and be lost. A dog soon forces them up a tree and if a knot-hole or other hollow is available they at once take refuge in it. Otherwise they hide skillfully in bunches of leaves high in the top or lie flat on a limb or against the trunk, slyly moving to keep on the opposite side as the hunter draws near. In the Mississippi Valley during the crisp days when the hickory nuts are falling and the trees are decked in all the glories of autumn foliage, few sports afield yield more pleasurable sensations than fox-squirrel hunting.

The fox squirrels become fatter than most of their kind and their flesh is not so dry, although all furnish appetizing meat. Owing to their size and the quality of their flesh, they have been such desirable game animals that with the constantly growing number of hunters and the destruction of forests they have already disappeared from large areas where formerly abundant and are in real danger of extermination in the not-distant future. They are among the most notable and attractive of the forest animals in the Eastern States, and before it is too late every effort should be made to protect them from overshooting. With reasonable conservation they will continue to thrive and keep some of the old-time primitive spirit in our woods. Formerly they had the same predilection as the gray squirrel for the farmers' corn fields and were under the ban, but their numbers are now so reduced that they give little trouble in this way. In some city parks where they have been introduced, they soon become tame and do well, except that in losing their fear of man they become subject to many accidents.

Fox squirrels, like many others of their kind, have homes both in knot-holes or other hollows in tree trunks, and in bulky nests of sticks and leaves high up among the branches. Both kinds of nesting places are often located in the same tree, the owner living in the outside nest in warm weather and retiring to the shelter of the hollow trunk in severe weather or to escape an enemy. The young, two to four in number, are usually born in March or April, and it is not definitely known whether there is a second litter. These squirrels have a barking call as well as several other rather deep-toned chucking notes.

They are as omnivorous as any of their kind, eating many kinds of nuts, seeds, fruits, mushrooms, insects, birds, birds' eggs, and other flesh food when available. The principal nuts in their haunts are hickory-nuts, beechnuts, walnuts, pecan nuts, and the seeds of pines and cypresses. Toward the end of summer and in fall they work busily gathering and storing food for winter in hollow trees, in old logs, about the roots of trees, and in any other snug place where it may be kept safely until needed. Many single nuts are buried here and there in little pits three or four inches deep dug in the soft surface of the earth under the trees. These scattered stores are located when needed by the acute sense of smell which the owners possess.

THE ABERT SQUIRREL (Sciurus aberti and its subspecies)

(*For illustration, see page 448*)

THE KAIBAB SQUIRREL (Sciurus kaibabensis)

(*For illustration, see page 448*)

Among the many kinds of squirrels which lend animation and charm to the forests of North and South America, none equal in beauty the subjects of this sketch—the Abert and the Kaibab squirrels. These are the only American squirrels endowed with conspicuous ear tufts, which character they share with the squirrels occupying the forests in the northern parts of the Old World from England to Japan. In weight they about equal a large gray squirrel, but are shorter and distinctly more heavily proportioned, with broader and more feathery tails.

Their range covers the pine-forested region of the southern Rocky Mountains in the United States and the Sierra Madre of western Mexico. The Abert squirrel and its several subspecies is the more widely distributed, being found from northern Colorado, south through

New Mexico, Arizona, Chihuahua, and Durango. The Kaibab squirrel, which is even more beautiful than its relative, shows marked differences in appearance and yet is evidently derived from the same species.

The typical Abert squirrel lives in the pine forests along the southern rim of the Grand Canyon in northern Arizona, and the Kaibab squirrel lives in the pines visible on the northern rim of the canyon less than 15 miles away. It is confined to an islandlike area of pine forest above 70 miles long by 35 miles wide, on the north side of the canyon, on the Kaibab and Powell plateaus, directly across from the end of the railroad at the Grand Canyon Hotel. The two species live under practically identical conditions as to vegetation and climate.

In these sketches of our mammal life I have repeatedly noted the effect of changing environment in modifying the animals subject to it. In the present case the change in the squirrels on the north side of the Grand Canyon has evidently been brought about by that powerful factor in evolution known as isolation. Cut off from their fellows by the deepening canyon of the Colorado, Kaibab squirrels have occupied a forest island ever since, with the resulting change in characters we now have in evidence.

The home of both the Abert and the Kaibab squirrels is almost entirely between 6,000 and 9,500 feet altitude, on the mountain slopes and high plateaus overgrown with a splendid open forest of yellow pine mixed in many places with firs and aspens. Occasionally, as food becomes scarce in their ordinary haunts, they range up into the firs or down into the oaks and piñon pines. In winter their haunts are buried in snow, but in summer on every hand present lovely vistas among the massive tree trunks, varied here and there by gemlike parks. Everywhere the ground is covered with grasses and multitudes of flowering plants. In the wilder parts of this fascinating wilderness roam bears, mountain lions, wolves, deer, and wild turkeys, and only a few decades ago still wilder men, belonging to some of our most dreaded Indian tribes.

Although these squirrels commonly make use of large knot-holes or other hollows in trees, they regularly build high up in the branches bulky nests of leaves, pine needles, and twigs and line them with soft grass and shredded bark. Sometimes several full-grown squirrels may be found occupying one of these outside nests, probably members of one family. They are active throughout the year, but remain in their nests during storms and severe winter weather. In northern Arizona I have known them to stay under cover for a week or two at a time in midwinter.

The young appear to be born at varying times between April and September. Although not definitely known, it seems probable that they have two litters of from three to four young each season.

The seeds and the tender bark from the terminal twigs of the yellow pine (*Pinus ponderosa*) furnish their principal food supply. During periods when pine seeds are not available the squirrels cut the ends of pine twigs, letting the terminal part bearing the leaves fall to the ground, while the stem, several inches in length, is stripped of bark. Often at times of food scarcity the bark will be eaten for a considerable distance along the outer branches, almost like the work of porcupines. The ground under the pines where the squirrels are at work is sometimes almost covered with the freshly dropped tips of branches.

The Abert squirrels also eat the seeds of Douglas spruce, of the piñon pine, acorns, many seeds, roots, green vegetation, mushrooms, birds' eggs, and young birds. Now and then they rob cornfields planted in clearings, but they do little damage to crops. Some years they are extremely numerous and are in evidence everywhere; again they become scarce and so wary that it is difficult to see one, even where its fresh workings are in evidence.

Both these squirrels have a deep churring or chucking call, sometimes becoming a barking note resembling that of the fox squirrel. They also have a variety of chattering and scolding notes when excited or angry. At times they become almost as aggressive as the red squirrel and come down the tree trunk or to a lower branch, whence they scold and berate the object of their disapproval.

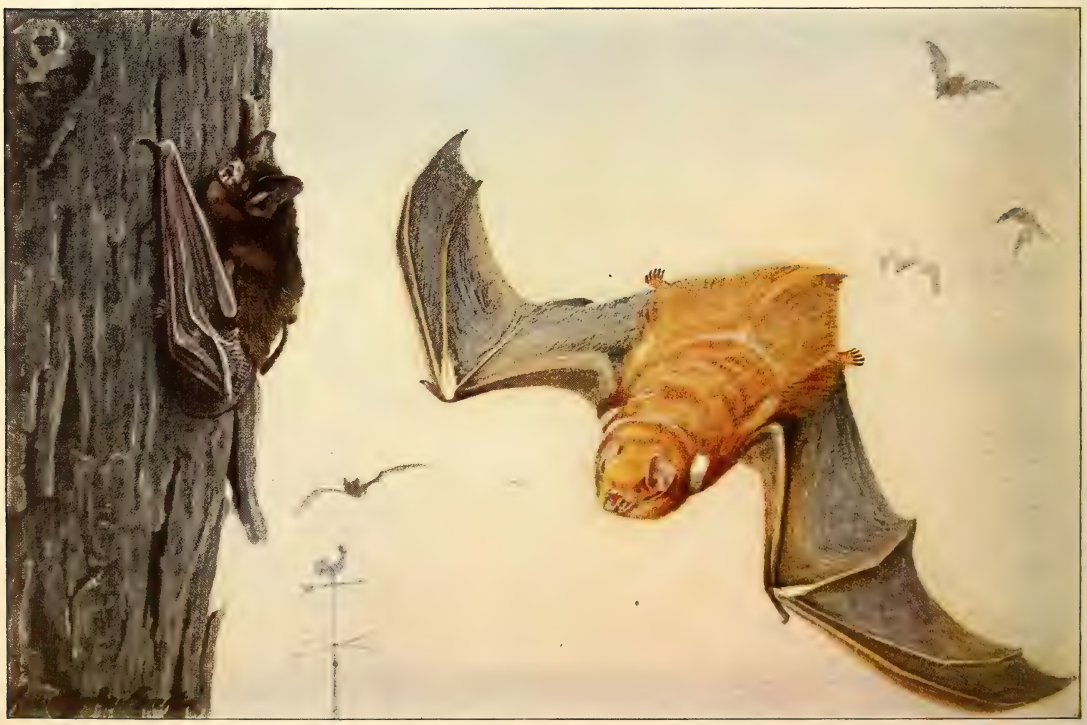
When much alarmed they are expert at hiding among tufts of leaves near the ends of branches, on tops of large limbs, or behind trunks. They will remain hidden in this way for an hour or more, patiently waiting for the danger to disappear, but one is often betrayed by the wind blowing the feathery tip of its tail into view.

On the ground the tail is usually carried upraised in graceful curves. Here these squirrels spend much time among fallen cones and in digging for roots and other food. When they walk they have an awkward waddling gait, but when they are alarmed, or desire to move more rapidly for any cause, they progress in a series of extremely graceful bounds, which show the plumelike tail to good advantage. When the Kaibab squirrel is moving about on the ground its great white tail is extraordinarily conspicuous in the sunshine. This repeatedly drew my attention to these squirrels, even at such long distances that they would otherwise have been overlooked.

Although so heavily built, these squirrels are adept in leaping from branch to branch and from tree to tree. On one occasion a branch on which an Abert squirrel was standing near the top of a pine tree was struck by a rifle ball; the squirrel promptly ran to the end of a large branch about fifty feet from the ground, and although no tree was anywhere near on that side, leaped straight out into the air, with its legs outspread just as in a flying squirrel. It came down in a horizontal position and struck the ground flat on its under side and the rebound raised it several inches. Without an instant's delay it was running at full speed across a little open park and disappeared in the forest

SHORT-TAILED SHREW
Blarina brevicauda

COMMON SHREW
Sorex personatus



HOARY BAT
Nycteris cinereus

RED BAT
Nycteris borealis

BIG-EARED DESERT BAT
Antrozous pallidus

MEXICAN BAT
Nyctinomus mexicanus

on the other side. I was standing only a few yards to one side of the falling squirrel and the widely spread feet and legs were perfectly outlined against the sky. It was evident that this squirrel and probably all of its kind appreciate that such an attitude will help break the force of the descent. This suggested the possibility of a similar habit having influenced the origin of the flying squirrel's membranes.

One summer day in the Sierra Madre of western Durango I sat on a mountain slope watching for game. Below me stood the hollow-topped stub of an oak, the top being on a level with my eyes and about twenty yards away. Soon after I arrived the heads of four half-grown squirrels of the Abert family appeared in a row at the upper border of the opening, their bright eyes turning on all sides. Suddenly a hawk glided by, one of its wing tips almost brushing the noses of the squirrels. Instantly they vanished from sight and a noise of scratching and frightened chattering continued for several minutes, as though they were burying themselves under the nest. About twenty minutes later the boldest of the family showed the tip of his nose at an opening in a hollow branch near the top of the stub, but it required another ten minutes for him to venture forth his head. Finally, becoming confident that no danger threatened, he came out on the limb and deliberately stretched himself, yawning as widely as his little mouth would permit, after which he flirted his tail and frisked over to the trunk of the stub, where he began frolicking about with all the abandon of a kitten at play. When I departed his more timorous companions were still peering fearfully out of the hole, anticipating the return of the dreaded hawk.

THE FLYING SQUIRREL (Glaucomys volans and its relatives)

(*For illustration, see page 449*)

No one can see one of our small flying squirrels in life without being charmed by its delicate grace of form and velvety fur, nor fail to note the large black eyes which give it a pleasing air of lively intelligence. Flying squirrels are distinguished from all other members of the squirrel family by extensions of the skin along the sides, which unite the front and hind legs, so that when the animal leaps from some elevated point with legs outspread the membrane and the underside of the body present a broad, flat surface to the air. This enables it to glide swiftly down in a diagonal course toward a tree trunk or other vertical surface on which it desires to alight. It is able to control its movements and to turn with ease to one side or the other, or upward before alighting. When gliding down a wooded hillside or through thick growths of timber, it is thus able to avoid obstacles and alight on the desired place.

Flying squirrels are circumpolar in distribution. In the Old World they occupy forested areas in eastern Europe, and nearly all of Asia. In the New World they are peculiar to North America, where they frequent nearly all the wooded parts from the Arctic Circle to the Mexican border, and in forests in Mexico along the eastern border of the highlands as well as through Chiapas and Guatemala. In Asia, the center of development of these interesting rodents, many extraordinary forms occur. Some are giants of their kind, measuring nearly four feet in total length. In America there are two groups of species, the smaller and better known of which, the subject of this sketch, occupies the eastern United States and southward. The northern and western animals are larger, some of them more than twice the weight of the eastern species.

In many parts of the United States flying squirrels are common and even abundant, but their habits are so strictly nocturnal that they are infrequently seen. They make their homes in woodpecker holes, knot-holes, and hollows in limbs, and trunks of trees and stubs. In addition they take possession of many odd places for residence, among which may be mentioned bird-boxes, dove-cotes, attics, cupboards, boxes, and other nooks in occupied or unoccupied houses that are located within or at the borders of woods.

They also make nests of leaves, lining them with fine fibrous bark, grass, moss, fur, or other soft material placed securely in the branches or in forks in trees. They often remodel old bird or squirrel nests into snug homes for themselves. The size and construction of these outside nests vary according to the locality and the material available.

As a rule, the nests are small and accommodate only a single pair with their young, and sometimes hold only a single individual, but numerous exceptions to this have been observed. In southern Illinois fifty flying squirrels were discovered in one nest in a tree; in Indiana fifteen were found in a hollow stump; and near Philadelphia thirty were evicted from a martin box they had usurped.

In the southern part of their range flying squirrels are active throughout the year, but in the North they become more or less sluggish if they do not actually reach the stage of real hibernation during the severest weather.

Their food is extremely varied and includes whatever nuts grow in their haunts, as beechnuts, pecans, acorns, and others, with many kinds of seeds, including corn gathered in the field, and buds, and fruits of many kinds. They also eat many insects, larvæ, birds and their eggs, and meat. Taking advantage of their known liking for bird flesh, they may frequently be caught by concealing a trap on top of a log in the woods and scattering bird feathers over and about it. Trappers for marten and other forest fur-bearers are much annoyed in winter by the persistence with which the flying squirrels search out their traps and become caught in them, thus forestalling a more valued capture. Trappers in Montana who run long lines of traps for marten through the mountain forests capture hundreds of these squirrels in a single season.

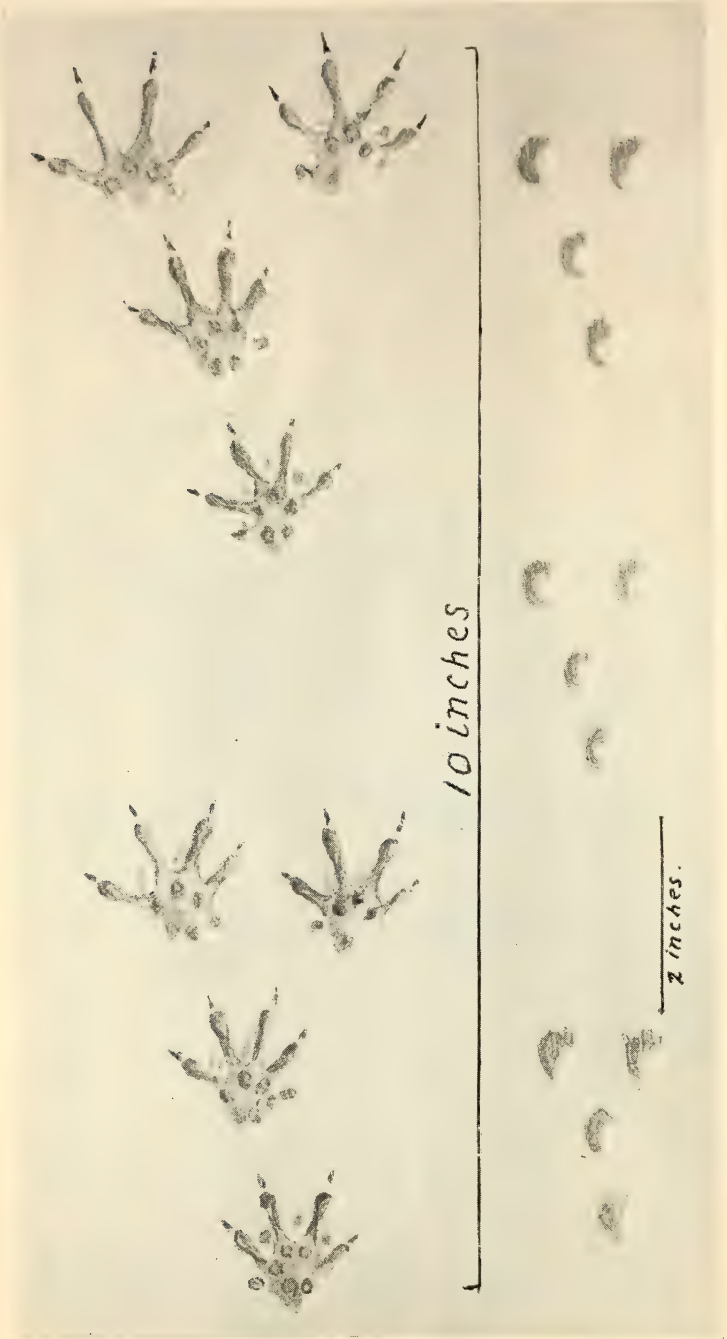
Flying squirrels have several notes, one of which is an ordinary *chuck, chuck,* much like that of other squirrels. They also utter sharp squeaks and squeals when angry or much alarmed, and a clear musical chirping note, birdlike in character, which is frequently repeated for several minutes in succession and is undoubtedly a song.

These beautiful little animals become the most delightful of pets, as they are notable for extraordinary playfulness and a readiness to accept man as a friend. Many interesting accounts have been published concerning the affectionate attachment they form for their human hosts and the amusing and tireless activity they show at night. By day they remain sound asleep, rolled up in a furry ball in some dark corner.

They are known to have a litter of from two to six young in April, and young are born at various times throughout the summer, but it is still unsettled whether there is more than one litter a year. The mother is devoted to the young, and if driven from them will keep close by at the risk of her life, showing much anxiety and readiness to do what she can to protect them. One instance well illustrates this maternal care. From a nest in a hollow stub the helpless young were taken and placed on the ground at its base, while the despoiler of the home stood by to observe the result. The mother soon returned and not finding her family in the nest promptly located them on the ground. Quickly descending, she took one in her mouth, carried it to the top of the stub and, launching into the air, sailed to a tree thirty feet away, up which she carried her baby and

THE TRAIL OF THE MUSKRAT

The usual gait of the muskrat on land is a slow walk. The tail mark is always very strongly shown (see pages 411 and 424).



THE TRACKS OF A GRASSHOPPER MOUSE

The anatomy of the foot is fairly well shown in the track—the insignificant thumb and the tubercles on the soles. The placing of the fore feet, one behind the other, indicates that the creature cannot climb a tree. The tail seldom or never shows. The original of this was in fine dust. The small tracks to the right show the style usually seen. There are many species of grasshopper mouse, but the tracks are not distinguishable from each other. The exact species is determined by locality, size, etc. (see pages 418 and 425).

placed it safely in a knot-hole. The trip was quickly repeated until the family was reunited in its new location.

At night the curiosity of flying squirrels about strange things and their mischievous activities are often most entertaining, and sometimes exasperating. Whatever is accessible within their territory is certain to be thoroughly explored. A large apartment building, seven stories high, in Washington stands on the border of the woods of the Zoological Park. During one summer night a friend occupying an apartment on the seventh floor of this building, fronting the park, observed some movement on one of his window sills and by later observation and by inquiry among the other residents learned that flying squirrels were habitually climbing all about the high walls to the top of this building, using it and some of the rooms as a nightly playground. Several occupants of apartments in different parts of the building regularly placed nuts of various kinds on the window ledges for them, and now and then were amused to find that during the night the squirrels had carried away some of their nuts, but had replaced them with other kinds, sometimes brought from a window at a considerable distance on another side of the building. The presence of these squirrels was warmly welcomed and furnished much interest to their hosts.

The constant activity of these little animals at night enables owls and cats to capture many, but their small size and the shelter of their homes by day will prevent their serious decrease in numbers so long as suitable forests remain to supply their needs.

THE BLACK-FOOTED FERRET
(Mustela nigripes and its relatives)

(*For illustration, see page 449*)

Of all the varied forms of mammalian life in America, the black-footed ferret has always impressed me as one of the strangest and most like a stranded exotic. It is about the size of a mink, but, as the illustration shows, is entirely different in appearance and has the general form of a giant weasel. It has no close relative in America, but bears an extraordinarily close resemblance in size, form, and color to the Siberian ferret (*Mustela eversmanni*).

The black-footed ferret occurs only in the interior of the United States, closely restricted to the area inhabited by prairie-dogs, from the Rocky Mountains eastward and from Montana and the Dakotas to western Texas. It is known also west of the mountains in Colorado. Like others of the weasel tribe, it must have a wandering disposition, since one was captured at 9,800 feet altitude, and another was found drowned at 10,250 feet in Lake Moraine, Colorado.

These ferrets exist as parasites in the prairie-dog colonies, making their homes in deserted burrows and feeding on the hapless colonists. In Kansas their presence in certain localities appears to have been effective in exterminating prairie-dogs, and similar activities may account for the deserted "dog towns" which are not infrequently observed on the plains with no apparent reason for the absence of the habitants.

They do not appear to be numerous in any part of their range and little is known concerning their habits. Now and then they are seen moving about prairie-dog "towns," passing in and out of the burrows at all hours of the day, but it is probable that they are mainly nocturnal. This probability is strengthened by the extreme restlessness shown at night by captive animals. With the occupation of the country and the inevitable extinction of the prairie-dog over nearly or quite all of its range, the black-footed ferret is practically certain to disappear with its host species.

It has the same bold, inquisitive character shown by the weasel, and when its interest is excited will stand up on its hind legs and stretch its long neck to one side and another in an effort to satisfy its curiosity. When surprised in a "dog town" it commonly retreats to a burrow, but promptly turns and raises its head high out of the hole to observe the visitor. As a result ferrets are readily killed by hunters. When one is captured it will at first hiss and spit like a cat and fight viciously, but is not difficult to tame.

Although mainly dependent upon prairie-dogs for food, there is little doubt that ferrets, after the manner of their kind, also kill rabbits and other rodents in addition to taking whatever birds and birds' eggs may be secured. In one instance a black-footed ferret lived for several days under a wooden sidewalk in the border town of Hays, Kansas, where it killed the rats harboring there.

THE LARGE WEASELS, OR STOATS
(**Mustela arcticus** and its relatives)

(*For illustration, see page 452*)

The weasel family includes not only the true weasels, but numerous other carnivores, as the sable or marten, mink, ferret, skunk, and land and sea otters, all of which rank among our highly valued fur-bearers. The large weasel may be distinguished from others of its family by the small size and the snakelike proportions of the flattened and pointed head, combined with a long, extremely slender neck and body and a comparatively long tail. The best known of these animals are the stoat of the northern parts of the Old World (*Mustela erminea*) and its close relative in northern North America (*Mustela arcticus*), the winter skins of which furnish the famed ermine, once sacred to the trappings of royalty.

The northern weasels are strongly marked by their habit of changing their brown coat to one of snowy white at the beginning of winter. To the south the change becomes less complete as the winter snows decrease, and south of the limit of snow the brown coat is retained throughout the year. The time of change depends on the coming of the snow and varies with the year, and the time of resumption of the brown coat in spring depends in the same way on the season. The white winter coat of the larger and medium-sized species is accompanied by a strongly contrasting jet black tip to the tail.

Weasels are circumpolar in distribution and occupy nearly all parts of Europe, Asia, and North and South America, the greatest number and variety of species occurring in North America. Surprisingly enough, the largest of these eminently northern animals is found in the forests of the American tropics. The Arctic weasel ranges to the northernmost polar lands of North America, where its presence has been recorded many times by ice-bound explorers. Other species are more or less generally distributed over the remainder of the continent. In Mexico I have found them from sea level to above timberline, at more that 13,000 feet altitude on the high volcanoes.

The strong personality of the weasels as a group is based mainly on their extraordinary celerity of movement, their courage, and their insatiable desire to kill. They are not satisfied with supplying the call for food, but whenever opportunity arises kill from sheer lust of slaughter.

Their slender forms enable them to follow their prey to the remotest depths of their retreats, and that all rodents have an abiding horror of them is shown by the effect of a weasel's appearance. Rabbits, although many times their size, become easy victims, and in one instance when a large rat, which had fought its human captor viciously, was put in a cage with a weasel, it at once lost all its courage and permitted itself to be killed without an effort at defense.

Weasels are wonderfully endowed for their

FOOTPRINTS OF A WHITE-FOOTED MOUSE

When reduced to scale, the large tracks on the left side are life size, showing the animal making the ordinary bounds of about 3 inches between each set of tracks. In speeding, the space may increase to 12 inches. The tail usually shows in the deermouse track, and this, with the pairing of the fore paws, is a strong characteristic (see pages 419 and 428).

predatory work and are undoubtedly the most perfectly organized machines for killing that have been developed among mammals. Their keen eyes are constantly alert to observe everything about them, their ears are attuned to catch the faintest squeak of a mouse or cry of any other small animal, and their powers of scent are very great. When hunting they dart in and out of the holes of rodents, among crevices in the rocks, or through brush piles, pausing now and then to stand upright on their hind feet, the head swaying to and fro as they peer about. The squeak of a mouse starts them instantly in search of it, and like a dog they trail rabbits and other rodents by scent.

As a rule, weasels are terrestrial, but in wooded country they climb trees and leap from branch to branch with all the ease of squirrels. In most localities they are not common, but now and then, where conditions are peculiarly favorable, they become numerous. At one naturalist's camp in the upper Yukon they were surprisingly abundant, so much so that more than forty were caught in a few days in traps set among broken rocks. There they were extremely bold, hunting for their prey among the rocks within a few feet of the trappers.

The prey of weasels includes almost every kind of small rodent and bird living within their territory. They feed especially upon northern hares, cottontails, conies, ground squirrels, chipmunks, tree squirrels, wood rats, mice, lemmings, quail, ptarmigan, spruce and ruffed grouse, ducks, and numberless other small species. They are also very destructive to domestic fowl, often killing thirty or forty in a night. They unhesitatingly attack rodents many times their own weight.

Once when hunting on the open plain near the southern end of the Mexican table-land, I saw at some distance what appeared to be a brown ball rolling about on the ground. This was soon determined to be a weasel fastened to one of the large and powerful pocket gophers of that region. The weasel had its teeth set in the back of the neck of the gopher, while the latter was blindly trying to tear itself loose. I fired an ineffectual shot at the weasel and it vanished like a flash in the open tunnel of the gopher. As I drew near, the gopher, still in fighting mood, faced me with bared teeth. Later, when I removed its skin, I found that the weasel had torn loose the attachment of the heavy neck muscles to the back of the skull until only a thin layer remained to protect the spinal column. This had been accomplished without breaking the thin, but extremely tough, skin of the gopher.

When a weasel is attacking an animal which resists, like a large ground squirrel, it raises its head and sways its long neck back and forth, its eyes glittering with excitement as it watches for an opening to spring forward and seize its prey. Its attack is always aimed at a vital point, commonly the brain, the back of the neck, or the jugular vein on the side.

Weasels dig their own burrows under the shelter of slide rock, ledges, stone walls, stumps, and outbuildings, or they occupy hollow trees and the deserted burrows of other animals. In

nests thus safely located they have one litter containing an average of from four to six, but sometimes numbering up to twelve, young a year. They are born at any time from April to June, according to the latitude. The number of young in a litter is enough to render weasels very abundant, but this is rarely the case, and raises the question as to the influence which holds their number in check.

They are both nocturnal and diurnal, apparently in almost equal degree, since they are frequently observed hunting in the middle of the day, while their nocturnal raids on poultry houses testify to their activities at night. When hunting they appear like sinister shadows and are persistent in pursuit. The young commonly remain with the female until nearly or quite grown and follow her closely on hunting trips. It is interesting to see a pack of these deadly carnivores working, the mother leading and the young skirmishing on all sides, now spreading out, now closing in, like a pack of miniature hounds. On these family hunting parties, however, they usually keep close to the rocks, logs, brush, or other cover.

Themselves subject to the law of fang and claw, weasels are killed and eaten by wolves, coyotes, foxes, and various birds of prey. Their very lack of fear perhaps in many cases leads to their destruction.

These representatives of the primitive woodland life continue to occupy practically all of their original range. They visit farms in all parts of the country and I have seen them near the outskirts of Washington.

It is well that weasels are not abundant, for beasts with such innate ferocity and love of killing would otherwise be a menace to the existence of many useful species of birds and mammals, especially the game birds. In many places they live almost entirely on mice, and there they should be left unmolested; but whenever they locate in the vicinity of a chicken yard the owner will do well to take proper measures for protection.

THE LEAST WEASEL (Mustela rixosus and its relatives)

(*For illustration, see page 452*)

In addition to the larger members of the tribe briefly described in the foregoing sketch, the true weasels include another group of species, so small they may appropriately be termed the dwarfs of their kind. They vary from a half to less than a fourth the size of the larger weasels, but have the same characteristic form and proportions, except that the tail is very short and never tipped with black. Like the larger species, they change their brown summer coat for white at the beginning of winter and back again in spring.

The least weasels are also circumpolar in distribution, but are limited to the northern parts of Europe, Asia, and North America. In England and other parts of the Old World the group is represented by the well-known species *Mustela vulgaris.* In North America several species are known which, between them, share all the continent from the Arctic coast south to Nebraska and Pennsylvania. On the desolate islands extending from the mainland far toward the Pole their place seems to be taken by the ermine.

The dwarf weasels appear to be less numerous and, as a consequence, less known in most parts of America than in England and northern Europe. Our most northern species, *Mustela rixosa,* sometimes called the "mouse weasel," occupies Alaska and northern Canada and has the distinction of being the smallest known species of carnivore in the world. In this connection it is interesting to note that in Alaska we have associated on the same ground the least weasel and the great brown bear, the smallest and the largest living carnivores.

Least weasels are characterized by the same swift alertness and boldness so marked in the larger species. In fact they are, if possible, even quicker in their movements. Once when camping in spring among scattered snowbanks on the coast of Bering Sea, I had an excellent opportunity to witness their almost incredible quickness. Early in the morning one suddenly appeared on the margin of a snowbank within a few feet, and after craning its neck one way and the other, as though to get a better view of me, it vanished, and then appeared so abruptly on a snowbank three or four yards away that it was almost impossible to follow it with the eye. It was beginning to take on its summer coat of brown and was extremely difficult to locate amid the scattered patches of snow and bare moss of the tundra. Certainly no other mammal can have such flash-like powers of movement.

They feed mainly on mice, lemmings, shrews, small birds, their eggs and young, and insects. Mice furnish a large proportion of their prey and weasels have often been seen following the runways of field mice. Their small size enables them to pursue mice into their underground workings as readily as a ferret enters a rabbit burrow. They also climb trees and bushes with great agility, although nearly always seeking their victims on the ground. The mice upon which they prey are often so much larger than the weasels that they cannot be dragged into the dens. The weasels continue in full activity throughout the winter and constantly burrow into the snow in search of their prey. In the snow or in the ground the holes of this animal are about the diameter of one's finger.

In the Old World the small weasels are reported to have several litters in a season, each containing five or six young. At Point Barrow, Alaska, a female captured on June 12 still contained twelve embryos. This indicates that only one litter a year would be born there, and that *Mustela rixosa* is more prolific than its European representative.

In the more southern latitude least weasels live in forests and about farms, sheltering themselves under logs, brush piles, stone walls,

THE COMMON BROWN RAT

The large series shows the ordinary foraging gait; the smaller one, to the right, shows the travel at low speed. In all, the tail mark is a strong feature (see pages 423 and 429).

and similar cover. They are always restless and filled with curiosity regarding anything of unusual appearance. When one encounters a man it shows no fear, but slyly moving from one shelter to another, now advancing and now retreating, examines the stranger carefully before going on its way. As they devote practically their entire lives to the destruction of field mice, they are valuable friends of the farmer and should have his good will and protection. Unfortunately for these weasels, no discrimination is shown between them and their larger relatives of more injurious habits.

Among the natives of Alaska all weasels are looked upon with great respect on account of their prowess as hunters. I found this feeling peculiarly strong among the Eskimos, whose existence for ages has depended so largely on the products of the chase. Among them the capture of a weasel meant good luck to the hunter, and to take the rarer least weasel was considered a happy omen. The head and entire skin of the least weasel was highly prized for wearing as an amulet or fetich. Young men eagerly purchased them, paying the full value of a prime marten skin in order to wear them as a personal adornment, that they might thus become endowed with the hunting prowess of this fierce little carnivore. Fathers often bought them to attach to the belts of their small sons, so that the youthful hunters might become imbued with the spirit of this "little chief" among mammals.

THE AMERICAN MINK (Mustela vison and its relatives)

(*For illustration, see page 453*)

In the American mink we have one of the most widely known and valuable fur-bearers of the weasel family. It is a long-bodied animal, but more heavily proportioned than the weasel, and attains a weight of from one and one-half to more than two pounds. It has short legs and walks slowly and rather clumsily with the back arched. When desiring to travel rapidly it moves in a series of rapid easy bounds which it appears able to continue tirelessly.

The minks form a small group of species circumpolar in distribution, and well known in Europe, northern Asia, and in North America. The European animal is closely similar to the North American species and all have the same amphibious habits. The American minks include several different geographic races, which are distributed over all the northern part of the continent from the Atlantic to the Pacific and from the mouths of the Yukon and Mackenzie Rivers to the Gulf coast in the United States. They are absent from the arid Southwestern States.

Few species are more perfectly adapted to a double mode of life than the mink. It is equally at home slyly searching thickets and bottomland forests for prey or seeking it with otter-like prowess beneath the water. It is a restless animal, active both by day and by night, although mainly nocturnal.

While usually having definite dens to which they return, minks wander widely and for so

small an animal hunt over a large territory and pass from one body of water to another. Their wanderings are most pronounced in fall and again during the mating in spring. They are solitary, their companionship with one another not outliving the mating period.

Mink dens are located wherever a safe and convenient shelter is available, and may be a hole in a bank, made by a muskrat or other animal, a cavity under the roots of a tree, a hollow log, a hollow stump, or other place. The nest is made of grass and leaves lined with feathers, hair, and other soft material. A single litter of from four to twelve small and naked young is born during April or May.

The young remain with the mother throughout the summer, and do not leave her to establish themselves until fall, when they are nearly grown. When captured at an early age they are playful and become attached to the person who cares for them. When caught in a trap they become fiercely aggressive, often uttering squalling shrieks, baring their teeth, and fronting their captor with a truculent air of savage rage. The adults have scent sacs located under the tail like those of a skunk. When angry or much excited they can emit from these an exceedingly acrid and offensive odor, but have no power to eject it forcibly at an enemy.

Minks are bold and courageous in their attitude toward other animals, and attack and kill for food species heavier than themselves, like the varying hare and the muskrat. On land they are persistent hunters, trailing their prey skillfully by scent. They eat mice, rats, chipmunks, squirrels, and birds and birds' eggs of many kinds, including waterfowl, oven-birds, and other ground-frequenting species. About the waterside they vary this diet by capturing fish of many kinds, which they pursue in the water, snakes, frogs, salamanders, insects, crustaceans, and mussels.

Their prowess is shown by their raids on chicken-houses, where they often kill many grown fowls in a night, and sometimes drag birds heavier than themselves long distances to their dens. A remarkable indication of the varied menu of the mink was exhibited in a nest found by Dr. C. H. Merriam, where the owner had gathered the bodies of a muskrat, a red squirrel, and a downy woodpecker.

The value of the mink's furry coat has led to its steady pursuit by trappers in all climes, from the coast of Florida to the borders of sluggish streams on Arctic tundras. Millions of them have fallen victims to this warfare and their skins have gone to adorn mankind. In spite of this the mink today occupies all its original territory, and each year yields a fresh harvest of furs.

The mink by preference is a forest animal, living along the wooded bottom-lands of rivers or the thicket-grown borders of small streams, where the rich vegetation gives abundance of shelter and at the same time attracts a wealth of small mammals and birds on which it may prey. From these secure coverts it wanders through the surrounding country at night, visiting many chicken-houses on farms and leaving devastation behind. It is persistent and bold in such forays and in locations near its haunts great care must be exercised to guard against it. Minks have repeatedly raided the enclosures of the National Zoological Park in Washington.

Now and then, on the banks of some wild stream, one will try to appropriate the catch lying at the very feet of a lone fisherman. A naturalist fishing on a stream in northern Canada, seeing a mink making free with his catch, set a small steel trap on the bare ground, and holding the attached chain in one hand raised and slowly drew toward him the fish upon which the mink was feeding. The mink, without hesitation, followed the fish and was caught in the trap.

An abundance of food may modify the preference of the mink for wooded or partly wooded country. The marshy and treeless tundra lying near sea-level in the triangle between the coast of Bering Sea, and the lower parts of the Yukon and Kuskokwim rivers offers such an attractive situation differing from their usual haunts. The sluggish streams and numberless ponds abound with small fish four to five inches long. Minks swarm in this area to such an extent that the Eskimos who inhabit the district are known among the natives of the surrounding region as the "mink people." Steel traps are used there, but a primitive method is even more successful. A wicker fence is built across a narrow stream and a small fyke fish-trap placed in it. In swimming along the stream minks pass into the trap like fish, and I knew of from 10 to 15 being thus taken in one day.

During my residence in that region from 10,000 to 15,000 mink skins were caught in this tundra district annually, and the supply appeared to be inexhaustible. With the growing occupation of the continent and the increasing demand for furs, however, the numbers of the mink must surely decrease. To forestall the shortage of furs that seems imminent, efforts are now being made to establish fur farming to replace the declining supply of wild furs with those grown under domestication. The mink appears to be well adapted to successful breeding in captivity. The main question to solve is the relation of the cost of caring for the animals to the value of its pelt in the market.

THE MARTEN, OR AMERICAN SABLE
(Martes americana and its relatives)

(For illustration, see page 453)

Wild animals possess an endless variety of mental traits which endow them in many instances with marked individualities. Few are more strongly characterized in this respect than the marten. One of the most graceful and beautiful of our forest animals, it frequents the more inaccessible parts of the wilderness and retires shyly before the inroads of the settler's ax. Its rich brown coat, so highly prized that

the pursuit of it goes on winter after winter in all the remote forests of the North, is a source of danger threatening the existence of the species. The full-grown animal weighs five or six pounds and measures nearly three feet in length.

The martens are circumpolar in distribution, and the several species occupy northern lands from England, Europe, and northern Asia to North America. Of the Old World species, the Siberian sable is best known on account of the beauty of its fine, rich fur, which renders it the most valued of all in the fur markets of the world.

The North American marten is a close relative of the Siberian species, and occupies all the wooded parts of North America from the northern limit of trees southward in the forested mountains to Pennsylvania, New Mexico, and the southern part of the Sierra Nevada in California.

Like other members of the weasel tribe, the marten is a fierce and merciless creature of rapine, but unlike the mink and weasel, it avoids the abodes of man and loves the remotest depths of the wilderness.

Martens are endowed with an exceedingly nervous and excitable temperament, combined with all the flashing quickness of weasels. They are more restless than any other among the larger species of their notably restless tribe, and couple with this extraordinary and tireless vigor. This is admirably shown in captivity, when by the hour they dart back and forth, up and down and around their cages with almost incredible speed.

In the forest they climb trees and jump from branch to branch with all the agility of a squirrel—in fact, they pursue and capture red squirrels in fair chase, and have been seen in pursuit of the big California gray squirrel (*Sciurus griseus*). On the ground they move about quickly, hunting weasel-like, under brush piles and other cover.

Practically every living thing within their power falls victim to their rapacity. They eat minks, weasels, squirrels, chipmunks, wood rats, mice of many kinds, conies, snowshoe hares, ruffed and spruce grouse, and smaller birds of all kinds and their eggs, as well as frogs, fish, beetles, crickets, beechnuts, and a variety of small wild fruits. Unlike minks and weasels, they are not known to kill wantonly more than they need for food.

They make nests of grass, moss, and leaves in hollow trees, under logs, among rocks, and in holes in the ground. Sometimes they have been found in possession of a red squirrel's nest, probably after having slain and devoured the owner.

The young, varying from one to eight in number, are born in April or May. At first they are naked and helpless, but when large enough accompany the mother on her search for food. This period of schooling lasts until they are forced to take up their separate lives with the approach of winter. Thenceforth they are among the most solitary of animals, showing fierce antagonism toward one another whenever they meet, and associating only during a brief period in the mating season in February or March. Martens show a cold-blooded ferocity toward one another that often renders it dangerous to put two or more in the same cage. When placed in a cage together the male very commonly kills the female by biting her through the skull. At times they utter a loud, shrill squall or shriek, and in traps hiss, growl, and sometimes bark.

Among the dense forests of spruce and lodgepole pine high up in the mountains of Colorado, martens are sometimes hunted on skis in midwinter, an exciting and often, on these rugged slopes, a dangerous sport. They are not wary about traps and are readily caught by deadfalls and other rude contrivances as well as by steel traps. In Colorado and Montana hundreds of their skins are taken by trappers every winter.

In Siberia the sable has been exterminated by hunting in many districts, and before the present war began had become so scarce in others that the Russian Government closed the season for them for a period of years over nearly all of their range. The same reduction in the numbers of our marten has occurred in most parts of Alaska and elsewhere in its range, and its only hope against extermination lies in stringent protection. Protective regulations are already in force in Alaska.

During the early fur-trading days in northern Canada the number of martens varied between comparative abundance and rarity. These variations were said to occur about every ten years. Some claimed the decrease was due to a migration which the martens were believed to make from one region to another, just as was believed of the lynx. The lack of a corresponding increase in surrounding districts, where trading posts were located, effectually disproved the migration theory. There is little doubt that the increase of martens was due to a reproductive response to a plentiful food supply during years when mice or snowshoe hares were abundant and their decrease was due to a lessening of the numbers of these food animals.

Efforts are being made to domesticate martens and raise them for their skins on fur farms. The main difficulty so far encountered lies in the fiendish manner in which the old males kill the females and the younger males. Although always nervous, they are not difficult to tame, and will be most entertaining and attractive animals to rear if their savage natures can be sufficiently overcome.

THE LITTLE SPOTTED SKUNK
(Spilogale putorius and its relatives)

(*For illustration, see page 456*)

The skunks form a distinct section of the weasel family, limited to North and South America. The group is divided into three well-marked sections. One of these, the little spot-

ted skunks, is distinguished from all other mammals by the curious and pleasing symmetry of the black and white markings of the animals. Few more beautiful fur garments are made than those from the skins of these animals in their natural colors. These skunks are smaller than any members of the other groups, varying from a little larger than a large chipmunk to the size of a fox squirrel.

Little spotted skunks include several species and geographic races. All are limited to North America and are rather irregularly distributed from the Atlantic coast to the Pacific and from Virginia, Minnesota, Wyoming, and southern British Columbia southward to the Gulf coast, to the end of Lower California, and through Mexico and Central America to Costa Rica. They inhabit a variety of climatic conditions, from the rocky ledges high up on the slopes of the western mountains to the hot desert plains of the Southwest, and to partly forested regions in both temperate and tropical lands. In different parts of the United States they have several other names, including "civet," "civet cat," and "hydrophobia skunk."

The spotted skunks make their homes in whatever shelter is most convenient, whether it be clefts in rocky ledges, slide rock, hollows in logs or stumps, holes dug by themselves in banks or under the shelter of cactuses or other thorny vegetation, the deserted holes of burrowing owls in Florida, or the old dens of various kinds of mammals elsewhere. Thickets, open woods, ocean beaches, and the vicinity of deserted or even occupied buildings on ranches are equally welcome haunts. On the plains of Arizona they have been known to live inside the mummified carcass of a cow, the sun-dried hide of which made an impregnable cover. They have a single litter of from two to six young each year.

Their diet is fully as varied as that of others of the weasel kind, but is made up mainly of insects and other forms injurious to agriculture, including grasshoppers, crickets, beetles, and larvæ of many kinds. They feed also on flesh whenever possible and prey on wood rats, mice of many kinds, small ground squirrels, small birds and their eggs, young chickens, lizards, salamanders, and crawfish. This carnivorous diet is further varied with mushrooms, peanuts, persimmons, cactus fruit, and other small fruits. Sometimes the animals locate about occupied habitations in primitive communities, where they give good service by killing the house rats, mice, and cockroaches on the premises. On one occasion a spotted skunk was detected cunningly removing the downy chicks from under a brooding hen without disturbing her.

In comparison with the other skunks these little animals are extremely agile. They are strictly nocturnal and when pursued at night by dogs will climb to safety in a tree like a squirrel. When caught in a trap they struggle and fight far more vigorously than their big relatives. They usually carry the tail in a somewhat elevated position, but when danger threatens hold it upright like a warning signal. If the enemy fails to take heed they shoot two little spraylike jets of liquid bearing the usual offensive skunk odor, and the victim retires without honor.

In writing of these skunks about the Valley

THE COMMON WOODCHUCK, OR AMERICAN MARMOT (SEE PAGES 431-432)

Its track shows this animal's kindship with the squirrels. The small series, to the left, show the ordinary ambling pace. When speeding, it sets its feet much like the little, or eastern, chipmunk (see page 477).

of Mexico, in 1628, Dr. Hernandez tells us that "the powerful arm which they use when in peril is the insupportable gas they throw out behind which condenses the surrounding atmosphere so that, as one grave missionary says, it appears as though one could feel it."

That the little spotted skunk is subject to rabies and has communicated it to many men in the West is unquestionable. It usually bites men who are sleeping on the ground in its haunts, as they commonly do on the western stock ranges.

I have personally known of several instances in northern Arizona of men being bitten by them. The head, face, and hands, being uncovered, are the points attacked. One man in the mountains south of Winslow, Arizona, was bitten on the top of his head in April, 1910, but paid no attention to the slight wound until two months later when he began to have spasms. He then hurried to town and died in great agony the next day. The year following a man in the same district was bitten in the face, and seizing the animal threw it from him in such a manner that it fell on his brother and bit him before he awakened. Both men were given the Pasteur treatment and had no further trouble.

On New Year's night of 1906, while I was at the village of Cape San Lucas, at the extreme southern end of the Peninsula of Lower California, a large-sized old male spotted skunk entered the open door of a neighboring house and bit through the upper lip of a little girl sleeping on the floor. Her screams brought her father to the rescue, and with a well-aimed blow he killed the offender. The next morning the skunk was brought to me and added to my collection. As I left a few days later I never learned the result of this bite, but while there was informed that a man had died the previous year from a similar bite. The occasional instances of this kind are remembered and appear more numerous than they are in fact. For years many men have slept in the open where these animals abound, without being molested. It is interesting to find that when the voyager Duhaut-Cilly visited the Cape in 1826, the natives feared these skunks because they entered houses at night, biting people and infecting them with hydrophobia.

The little spotted skunks have extremely animated, playful natures, as I have had several occasions to observe. Two instances serve to illustrate this. Once at the mouth of a canyon at the southern end of the San Joaquin Valley, California, I camped several days at a deserted ranch. At night I spread my blankets on the bare floor of the house, from which the doors were gone. Under it led several burrows of some animal which I at first supposed to be a ground squirrel. Each night while there I was awakened by the sound of little footfalls padding rapidly about over the floor on which I was sleeping, and in the dim light from the moon could see two or three little spotted skunks pursuing one another around me like playful kittens. At the slightest movement on my part they dashed out the door and into their dens under the house. As there was no food of any kind in this room, it was evident that the little fellows were there for a frolic on the smooth board floor.

On another occasion in the mountains of San Luis Potosi, on the Mexican table-land, I found a spring to which bears were coming for water at night. As the bears here appeared to be strictly nocturnal, I ensconced myself in the evening with a dark lantern, amid some small bushes, against a large pine log which sloped downward to the bottom of the gulch near the spring, with the plan to welcome any bears which might come in. An hour or more after dark the clinking rattle of small stones on the far side of the gulch indicated the presence of some animal. The light from the lantern was flashed on the spot and the rifle lowered with exasperation as, running back and forth, turning over stones in search of insects, a spotted skunk was revealed. The movements of this unwelcome visitor were extremely light and graceful, and in my interest in watching them, for a time I forgot the bear. Two or three hours passed and the skunk tired of the hillside and came down to the spring, where he found the offal from a deer which I had placed there for bait. This gave him more to do, and after I had listened to him worry the meat for awhile, I turned on the light and was entertained by the sight thus revealed. The skunk appeared to have a persistent desire to drag away the offal many times his weight. He would seize the edge of one of the lungs and after a hard struggle would get it up on one edge, when the burden would turn over with a flap, whirling the skunk flat on his back each time. Immediately scrambling to his feet, he would give the meat a fierce shake of resentment and repeat the performance.

After a long time the moon arose and the skunk could be plainly seen running back and forth playfully, now biting at the meat and now turning over stones apparently in sheer exuberance of spirit. Then he suddenly mounted the lower end of the log and came galloping up it until he was close to my shoulder. There he stopped and, coming as near as possible, extended his nose within a few inches of my face, and for minute or more stood trying to satisfy himself about this strange object. Satisfied at last, he turned and galloped back down the log and resumed his antics in the gulch, finally working close to the bank three or four yards below me. There he found many small stones and had a fine time rattling them about until I decided that with this disturbing presence I should have little chance for other game. Finding a convenient stone, and locating the skunk as well as possible from the sounds, I tossed it over to try and frighten him away. My aim was too true, for the characteristic skunk retort filled the air with suffocating fumes and I immediately lost interest in further bear hunting.

THE COMMON SKUNK (Mephitis mephitis and its relatives)

(*For illustration, see page 456*)

Probably no American mammal is more generally known and less popular than the skunk. This current odium is due wholly to its possession of a scent sac of malodorous fluid, which it distributes with prompt accuracy when annoyed. The possession of this method of defense is common to all skunks. The term "polecat," sometimes given to all kinds of skunks, is the misuse of a name given Old World martens of several species and to the Cape pole-cat, a South African animal which in form and markings, including the plumelike tail, is remarkably like some of our smaller skunks.

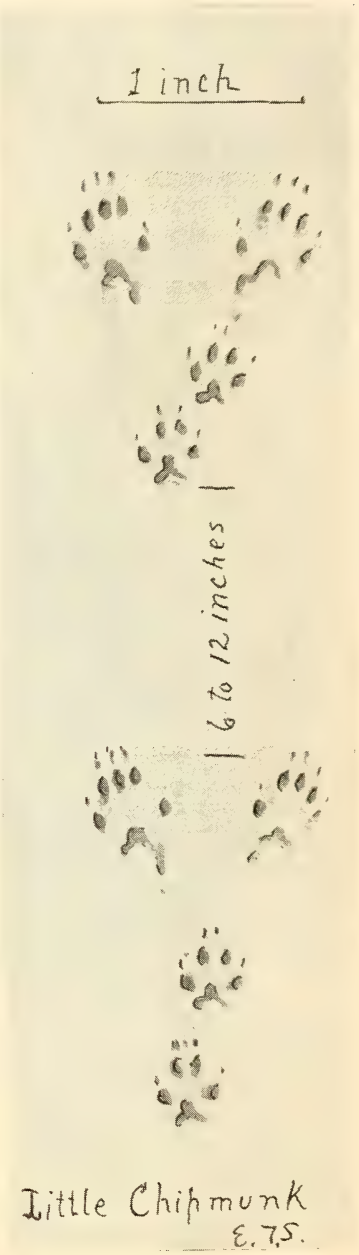
In the preceding article an account was given of the spotted skunks, smallest of the three groups into which these animals are divided. The common skunk and its relatives form another group, which contains some of the larger species of their kind, some of them weighing up to ten pounds or more. These are the typical skunks, so familiar in most parts of the United States, and distinguished by the disproportionately large size of the posterior half of the body and the long, plumelike tail.

The common skunk, with its closely related species, is generally distributed in all varieties of country, except in deep forests and on waterless desert plains. It ranges from the Atlantic coast to the Pacific and from Hudson Bay and Great Slave Lake southward to the highlands of Guatemala. The vertical range extends from sea-level up to above timberline in Mexico, where I found one living in a burrow it had dug under a rock at 13,800 feet altitude on the Cofre de Perote, Vera Cruz.

Skunks are most common in areas of mixed woodland and fields, in valley bottoms, and along the brushy borders of creeks and rocky canyons. One of their marked characteristics is a fondness for the vicinity of man. They frequently visit his premises, taking up quarters beneath outbuildings or even under the house itself.

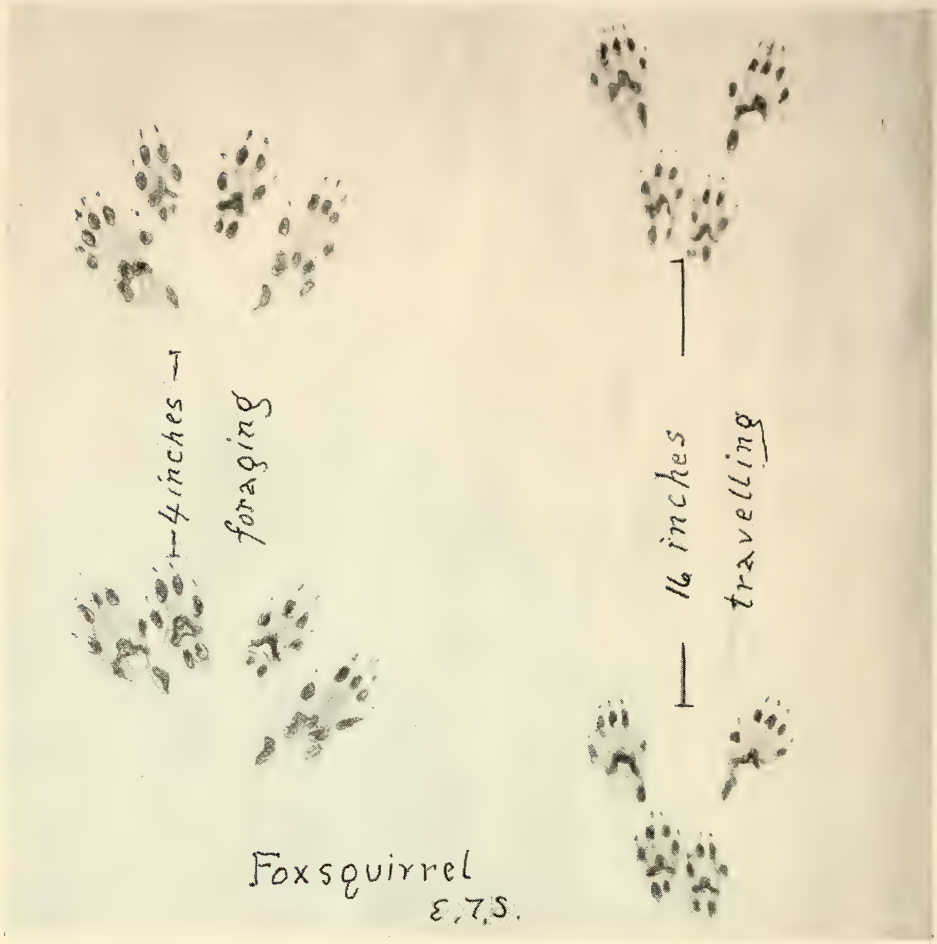
Any convenient shelter appears to satisfy them for a home, and they will occupy the deserted burrows of other animals, small cavities among the rocks, a hollow log, or a hole dug by themselves. A warm nest of grass and leaves is made at the end of the den, where the single litter of young, containing from four to ten, is born in April or May. As soon as the young are old enough they follow the mother, keeping close behind her, often in a long single file along a trail. They are mainly nocturnal, but in summer the mother frequently starts out on an excursion with her young an hour or two before sunset and they may remain abroad all night.

The young family remains united through the following winter, which accounts for finding at times from eight to a dozen in a den. In all the northern parts of their range they hibernate during the two to four months of severest cold weather, coming out sometimes during mild periods. When the season of hibernation ends the family scatters and mating begins. One solitary skunk was found in Canada hibernating



THE TRAIL OF THE EASTERN CHIPMUNK

The track is much like that of the fox squirrel, but usually the fore feet are a little, or quite, one behind the other and, of course, much smaller. No tail mark is ever seen (see pages 440 and 447).



THE TRACKS OF A RUSTY FOX SQUIRREL AND FOX SQUIRREL

The exaggerated pads of the squirrel foot are a strong feature of this track. It is typical in the pairing of the fore feet, much more so than that of the gray squirrel. There is never a tail mark in this track (see pages 445 and 459).

in the same burrow, but in a separate chamber, with a woodchuck, evidently an unbidden guest.

As in the case of their relatives, the common skunks are omnivorous, but feed mainly upon insects and rodents injurious to agriculture. They are known to eat great quantities of grasshoppers, besides crickets, cicadas, May beetles, wasps, and larvæ of many kinds. One killed in New Mexico had its stomach crammed with honey bees. Wherever possible they prey upon small rodents, as mice, wood rats, and small spermophiles. To these may be added ground-nesting birds and their eggs, lizards, turtle eggs, snakes, frogs, salamanders, fish, crustaceans, and numerous small fruits. Now and then they visit the farmers' chicken yards with such disastrous consequences that in many country districts the animals are killed at sight.

It is pleasing to record that a more intelligent view of their real value to farmers, through their destruction of farm pests, is rapidly gaining ground, and they are now being protected in many States. One of their worst traits is their destructiveness to breeding game birds, both upland species, and especially the waterfowl.

Skunks walk on the soles of their feet instead of on their toes, as do so many mammals. The common skunks are wholly terrestrial and move with the deliberation of one without fear of personal violence or of having his dignity assailed. Long experience has taught them that the right of way is theirs. As they amble slowly along, the tail is carried slightly elevated, and when the owner is suspicious of attack, it is raised and the hairs hang drooping like a great plume, conspicuous and unmistakable. If the disturber still refuses to take the hint, a

A FULL SIZE RENDERING OF A FOX SQUIRREL TRACK

Illustrations of the arrangement of this track when the animal is foraging and traveling are shown on the opposite page

rear view is promptly presented and a discharge made that puts most enemies to flight. Some have thought that the odorous liquid is scattered by the long hairs of the tail, but in fact it is ejected in fine jets from two little tubes connected with the scent sacs on each side of the vent.

When mildly annoyed the big skunks stamp their front feet on the ground and utter little growls of displeasure. By some effort they can be urged into a retreat which may take the form of a clumsy gallop. They are known occasionally to swim streams voluntarily, and even to cross rivers, probably urged by the instinct that so often forces animals of all kinds to move to new feeding grounds.

Although usually safe from annoyance through the protective armament, many skunks, especially the young, each year fall victim to natural enemies, including wolves, coyotes, foxes, badgers, and great horned owls.

The flesh of the skunk is a favorite food among certain tribes of Canadian Indians, and many white men have pronounced it exceedingly palatable, even claiming its superiority over the flesh of domestic fowls. In the narrative of his expedition through the Canadian wilderness many years ago, the naturalist Drummond recorded that when the party was about a day's journey from Carleton House it had the good fortune to kill a skunk, "which afforded us a comfortable meal." In the Valley of Mexico I found the natives prize the flesh of these animals as a cure for a certain loathsome disease.

It is well known that large skunks are often extremely fat. The oil produced from them is clear and is said to have unusually penetrating qualities. For many years there was a demand for this oil for various medicinal purposes.

During recent years the fur of skunks has come into great demand, and good prices are paid for prime skins. The animals are so numerous and the catch is so large that they now rank among the most valuable of our fur-bearers. They are gentle animals which readily become domesticated and breed freely in confinement, and many efforts are being made to establish skunk farms. Success in such farming depends wholly on the outlay for upkeep. Skunk farming will probably pay better as a side line, like chickens on the ordinary farm, than to establish regular fur farms. The scent sac may be removed by a slight surgical operation, so there need be no trouble from that source. Common skunks when taken young make affectionate and entertaining pets. They become as tame and playful as kittens, and are vastly more intelligent and interesting.

THE HOG-NOSED SKUNK (Conepatus mesoleucus and its relatives)

(*For illustration, see page 457*)

The third and last group of skunks contains a number of species showing well-marked differences from the two groups already described. The species vary in size, but among them is included the largest of all skunks. All are characterized by comparatively short hair, es-

pecially on the tail, and this appendage lacks the plumelike appearance observed in other skunks. The nose is prolonged into a distinct "snout," naked on the top and sides and evidently used for rooting in the earth after the manner of a pig. In addition, the front feet are armed with long, heavy claws, and the front legs and shoulders are provided with a strong muscular development for digging, as in a badger. This likeness has led to the use in some places of the appropriate name "badger skunk" for these animals. The single white stripe along the back, and including the tail, is a common pattern with these skunks, but this marking is considerably varied, as in the common species.

The hog-nosed skunks are the only representatives of the skunk tribe in South America, where various species occupy a large part of the continent. They appear to form a South American group of mammals which has extended its range northward through Central America, Mexico, and across the border of the United States to central Texas, New Mexico, and Arizona. In Mexico they range from sea-level to above 10,000 feet altitude on the mountains of the interior.

The hair on these skunks is coarse and harsh, lacking the qualities which render the coats of their northern relatives so valuable. Where their range coincides with that of the common skunks, the local distribution of the two is practically the same. They live along the bottom-lands of watercourses, where vegetation is abundant and the supply of food most plentiful, or in canyons and on rocky mountain slopes.

For shelter they dig their own burrows, usually in a bank, or under a rock, or the roots of a tree, but do not hesitate to take possession of the deserted burrows of other animals, or of natural cavities among the rocks. Owing to their strictly nocturnal habits, they are much less frequently seen than the common skunks, even in localities where they are numerous. In fact it is only within the last few years that their presence in many parts of the southwestern border has become known.

Although both the little spotted and common skunks live mainly on insects, the hog-nosed skunks are even more insectivorous in their feeding habits. The bare snout appears to be used constantly for the purpose of rooting out beetles, grubs, and larvæ of various kinds from the ground.

On the highlands of Mexico I have many times camped in localities where patches of ground were rooted up nightly by these skunks to a depth of two or three inches as thoroughly as might have been done by small pigs. In such places I repeatedly failed to capture them by traps baited with meat, the insects and grubs they were finding apparently being more attractive food. I have had similar failures in trapping for coyotes with meat bait in localities where they were feeding fat on swarms of large beetles and crickets. The persistence with which the hog-nosed skunks hunt insects renders them a valuable aid to farmers.

In addition to grasshoppers, crickets, beetles, flies, grubs, and other larvæ, and many other insects, they are known to eat wood rats, mice, and the small fruit of cactuses and other plants. The stomach of one of these skunks examined in Texas contained about 400 beetles.

One Texas naturalist writes that he has lost a number of young kids which had their noses bitten off, and in one instance caught one of these skunks mutilating a kid in this manner. He also states that they pull down and eat corn when it is in the "roasting-ear" stage.

Far less is known concerning the habits of hog-nosed skunks than of the other species of these animals. The number of young appears to be small, judging from the record of a single embryo found in one animal and in another instance of two young found in a nest located in a hollow stump. They have a curiously stupid, sluggish manner and have even less vivacity than the somewhat sedate common skunk. No use is made of their skins in this country or in Mexico, but the gigantic natives of Patagonia make robes of them which are worn like great cloaks.

THE NINE-BANDED ARMADILLO
(Dasypus novemcincta and its relatives)

(*For illustration, see page 457*)

Armadillos are distinguished from other mammals by having the nearly, or quite, hairless skin developed into a bony armor covering the upperparts of the head and body and all of the tail. They lack teeth in the front of both upper and lower jaws, and are members of the group of toothless animals which includes the ant-eaters. The insects they feed on are licked up by the sticky surface of their extensile tongues.

In the remote past many species of armadillos, some of gigantic size, roamed the plains of South America, and a number of small species still exist there. These animals are peculiar to America and have their center of abundance in the southern continent.

The nine-banded species ranges over an enormous territory and is subdivided into a number of geographic races, living from southern Texas through Mexico and Central America to Argentina. In Mexico its vertical distribution extends from sea-level up to an altitude of about 10,000 feet on the mountains of the interior. Like the hog-nosed skunk, it no doubt originated as a member of the South American fauna and has spread northward to its present limits. It is one of the larger of the living representatives of this curious group of animals and reaches a weight of from twelve to fifteen pounds.

As might be surmised from its appearance, the armadillo is a stupid animal, living a monotonous life of restricted activities. Its sight and hearing are poor, and the armored skin gives it a stiff-legged gait and immobile body. From these characteristics, combined with the small head hung low on a short neck, it has in life an odd resemblance in both form and

motion to a small pig; it jogs along in its trails or from one feeding place to another with the same little stiff trotting gait and self-centered air. If alarmed it will break into a clumsy gallop, but moves so slowly that it may be overtaken by a man on foot. So poor is its eyesight that a person may approach openly within about thirty yards before being noticed.

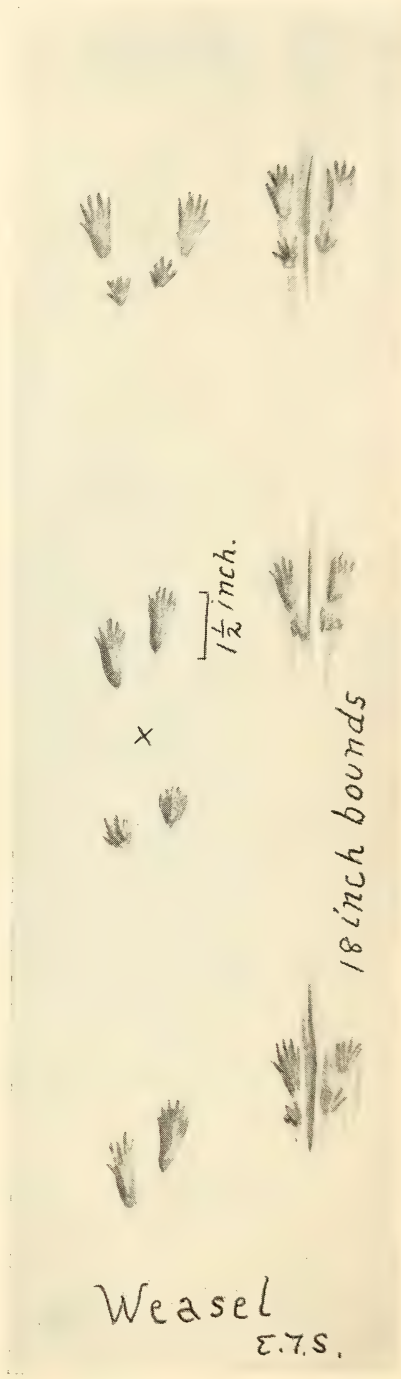
When alarmed the armadillo immediately runs to the shelter of its burrow, but may easily be caught in one's hands, especially if intercepted on the way to its den. When caught it will struggle to escape, and while it may coil up in a ball in the presence of a dog or other mammal foe, I never saw one try to protect itself in this way. While presumably serving for protective purposes, the armor is flexible on the sides of the body, and I have found the remains of many armadillos where they had been killed and eaten by coyotes or other predatory beasts. The armor would no doubt be sufficient protection to enable them to escape to cover from the attack of birds of prey. They are mainly nocturnal animals, but are frequently seen abroad by day and in some places appear to be out equally by day or night.

This armadillo lives by preference amid the cover afforded by forests, brushy jungle, tall grass, or other vegetation. In the midst of such shelter it usually digs its own burrow a few yards deep in a bank or hill slope, beneath a stump, under the roots of a tree, or a rock, or even on level ground. It will also occupy small caves in limestone rock. At times it shows a piglike fondness for a mud bath, and the prints of its armor may be found where it has wallowed in miry spots.

Well-beaten and conspicuous trails lead from the burrows often for half a mile or more, frequently branching through the thickets in various directions. Armadillo burrows sometimes accommodate strange neighbors, as was shown by one in Texas which was dug out, and in addition to containing the owner in his den at the end, was found to be occupied by a four-foot rattlesnake and a half-grown cottontail rabbit, each in a side chamber of its own.

The food of the armadillo consists almost entirely of many species of insects, among which ants appear to predominate. When searching for food the animals become so intent that they may be cautiously approached and closely observed or captured by hand. They root about among fallen leaves and other loose vegetation and soft earth, now and then digging up some hidden grub or beetle. At night they visit newly plowed fields in their haunts, rooting in the mellow earth. They are accused of digging up plants in gardens during their nocturnal wanderings, and in Texas have been charged with robbing hens' nests of eggs, and of reducing the supply of wild turkeys and quail by breaking up the nests, all of which needs confirmation. Their method of feeding appears to vary considerably, as they have been seen rising on their hind legs to secure small caterpillars infesting large weeds.

The insect food eaten by the nine-banded armadillo in Texas, as known from examina-



THE TRACK OF THE WEASEL

The unusual space between the fore and hind feet in the middle of the left series is often seen. Sometimes the tail mark is there and sometimes not. Sometimes the trail is like that of a small mink. The toes seldom show (see pages 452 and 469).

AMERICAN MINK TRACKS, SHOWING VARIOUS ARRANGEMENTS AND TAIL MARKS

The typical track of a mink is as in the bottom set at the left, which also illustrates the tail mark. Twelve to twenty-four inches are usually cleared at each bound. This illustration is greatly reduced from natural size (see opposite page and pages 453 and 472).

tion of stomach contents, covers a wide range of insect and other small life, including many species of grasshoppers, crickets, roaches, caterpillars, beetles, ants, spiders, centipedes, and earthworms. As the list includes also wireworms and other noxious species, these inoffensive animals deserve thorough protection as a most useful aid to the farmer.

Some time from February to April each year, litters of from four to eight young are born. They have their eyes open at birth, and the armor is soft and flexible like fine leather. The hardening of the skin into a bony armor is progressive, continuing until after the animal fully completes its growth. As soon as the young are able to travel they trot along with the old one during her foraging trips.

Early one afternoon, when riding along a trail in the heavy forest of southern Oaxaca, accompanied by an Indian boy and a pack of dogs, I suddenly came upon an old armadillo and eight young about two-thirds grown. They had heard our approach and stood motionless in a compact little group half hidden in the grass. I had barely time to stop my horse when the dogs spied them and made a rush. The armadillos darted into the undergrowth in every direction like a litter of pigs, and with the exception of two caught by the dogs gained safe refuge in their burrow. This we found dug in the level ground about fifty yards from where we encountered them.

The Maya Indians of the peninsula of Yucatan have a legend that the black-headed vulture (*Catharista atrata*) in old age changes into an armadillo. The tale runs, that when a vulture becomes very, very old it notifies its companions that the time has come and alights before a hole in the ground that resembles the den of an armadillo. The other vultures bring food and the old one remains there for a long time. Its wings disappear, the feathers are lost, and when the change is complete the newly created armadillo enters the hole and begins its new life. If skepticism is expressed as to this metamorphosis, the Indians point out as proof of the legend the similarity between the appearance of the bald pate of the vulture and that of the armadillo.

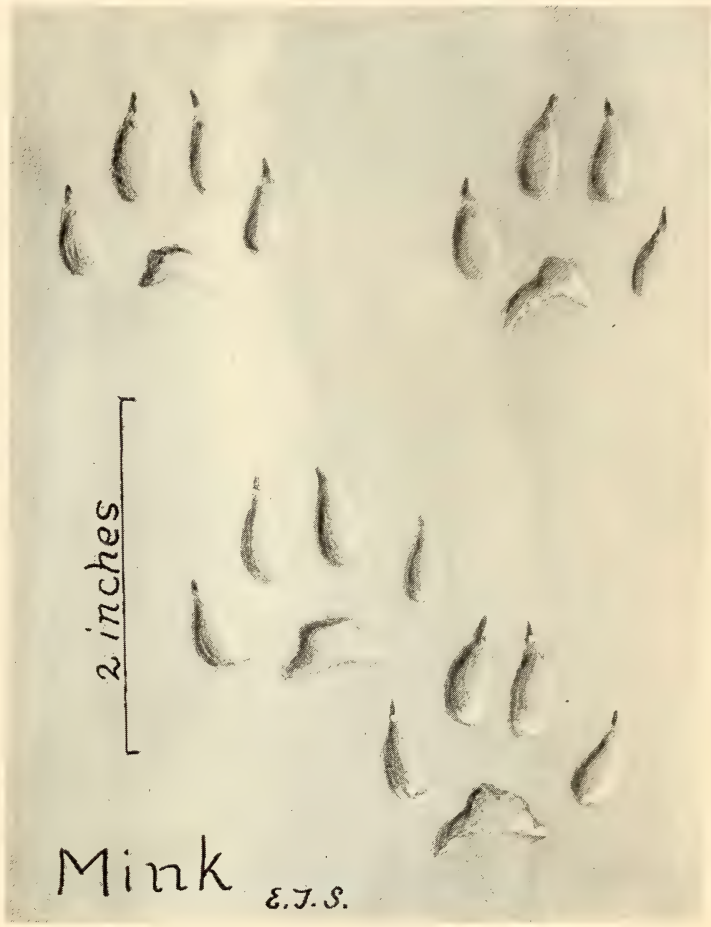
THE RING-TAILED CAT (Bassariscus astutus and its relatives)

(*For illustration, see page 460*)

The mild climate and the proximity of the Southwestern States to Mexico and the tropics brings within our borders numerous strange types of wild life. Of these the ring-tailed cat is one of the most strikingly marked and interesting. In the United States it is known by several other names, including "civet cat," "coon cat," and "band-tailed cat." In Mexico it still bears the old Aztec name cacomixtle, except in Lower California, where it is the

"babisuri." It is about the size of a large cat, but with proportionately longer and slenderer body, shorter legs, and longer tail. The alternating bands of black and white on the tail proclaim its relationship, not to the cat, to which it has no kinship, but to the raccoon, which has a tail similarly marked. Few mammals possess such a beautifully formed head and face, and its large, mild eyes give it a vivid expression of intelligence.

The ring-tailed cat occupies areas under such differing climates as to produce geographic races, but none of them vary strikingly from the typical animal here illustrated. They range from Oregon, Nevada, southern Utah, Colorado, and Texas south to Costa Rica. In Mexico they occur from near sea-level up to an altitude of about 10,000 feet. While chiefly rock-inhabiting species, they sometimes live in the forest and as a rule make their dens in caves and deep crevices, but sometimes in hollow trees or about houses. Their young, from three to four in number, are born in May or June.



AMERICAN MINK TRACK NEARLY NATURAL SIZE

Although this animal has five toes on each foot, only four appear in each track. This illustration, which is practically natural size, shows the usual arrangement of the track. The hind feet are, of course, in advance. Variations of arrangement are shown on the opposite page (see also pages 453 and 472).

In the Southwest they frequent some of the ruined cliff dwellings, and I have found them haunting many of the ancient ruins of Mexico. Their presence in little caves and other sheltered spots along cliffs and rock walls bordering canyons or on mountain slopes may usually be known by an examination of the fine dust which accumulates in sheltered places. Whenever present their delicate cat-like tracks will be found where they have been hunting mice or other small game.

Strictly nocturnal, they do not sally forth from their dens until darkness is complete. During the night they are restless and frequently wander far and wide in search of food, and apparently at times merely to satisfy a spirit of inquiry. Their inquisitive nature frequently leads them to explore the streets of towns and cities on the Mexican table-land, filled though these places are with dogs. At daybreak, tracks left in the dusty streets tell the story of their wanderings, as they often do also in the case of opossums.

One morning in February, 1893, soon after sunrise, I chanced to pass through a little wooded square in the City of Mexico and saw a lot of boys pursue and capture one of these animals which, having overstayed its time, had been surprised by daybreak. This wanderer might have had its den in some house in the neighborhood, since one of its known habits is to take up its abode about houses, even in the midst of towns. A friend living in the City of Mexico informed me that after having been annoyed for some time by noises on the roof at night, he investigated and discovered a female cacomixtle with partly grown young

snugly located in a nest placed in a narrow space between the tile roof and the ceiling. In southern Texas the animals live on the brush-grown plains under conditions very different from those usually chosen.

Like its relative the raccoon, the cacomixtle, with a taste for a varied fare, takes whatever edibles come its way. It stalks wood rats, mice, and even bats amid their rocky haunts and birds in bushes and low trees. About the southern end of the Mexican table-land it is much disliked for its robberies of chicken roosts, especially when these are located in trees. Insects of many kinds, larvæ, and centipedes are eaten, as well as a great variety of fruits, including that of the pear-leaved cactus, and dates, figs, and green corn.

Ring-tailed cats regularly locate among rocky ledges, neighboring orchards, or other cultivated areas where they may gather some of the bounty provided by man. I found them more plentiful among the broken lava cliffs bordering date palm orchards in Lower California than in any other place. When the dates were ripening they prowled about under the palms after dark with gray foxes and spotted skunks to pick up the fallen fruit. They sometimes uttered a complaining cry and when caught in a trap would bark almost like a little dog, or occasionally utter a vicious scream of mixed fear and rage.

Being an intelligent animal, the cacomixtle is readily tamed and makes a most interesting pet. During the early years of gold mining in California, when many men were living in rude cabins in the mountains, the prevalence of mice often attracted these "cats" to take up their residence there. Often the owner of the premises and the mouser struck up a friendly relationship and the cacomixtle, becoming as free and friendly about the place as a real cat, kept it entirely clear from mice. I have had first-hand accounts of these tame individuals from miners who had harbored them in this way for months. These accounts always gave the impression that the animal was somewhat playful and mischievous and most attractive to have about the premises. All agreed that it was extremely fond of sugar.

THE OREGON MOLE (Scapanus townsendi and its relatives)

(*For illustration, see page 461*)

The effect on mammals of a narrowly specialized mode of life is well illustrated in the mole. It is an expertly constructed living mechanism for tunneling through the earth. The pointed nose, short neck, compactly and powerfully built cylindrical body, with ribs strongly braced to withstand pressure, and the short, paddlelike hands armed with strong claws for digging are all fitted for a single purpose. Eyes and ears are of little service in an underground life, so they have become practically obsolete; the fur has been modified to a compact velvety coat which will lie either front or back with equal facility and thus relieve any friction from the walls of the tunneled roads, no matter which way the animal travels.

Moles are circumpolar in distribution, being found from England to Japan in the Old World and on both the Atlantic and Pacific coasts of the New World, where they occur only in North America. On this continent they are limited mainly to the United States and southern Canada, extending across the Mexican border only in two limited areas at the extreme east and west. Their distribution is not continuous across the continent, but is broken by a broad unoccupied belt formed by the arid interior, including the Great Basin. The home of the Oregon mole lies in the humid area west of the Cascade Mountains in Washington, Oregon, and extreme northwestern California. Closely related forms range from eastern Oregon southward through California to the San Pedro Martir Mountains in Lower California, and others north into British Columbia.

The Oregon mole is the largest and handsomest member of the group in America and perhaps in the world. Its skin, a velvety coat of nearly black fur, often with a purplish sheen, now brings a higher price in the market than that of any other species. Its size and the beauty of its dark coat distinguish it from any other mole.

Where the soil is loose the mole practically swims through it, urged forward by powerful impulses of its "hands" and feet. This is the common mode of travel near the top of the ground, where the course is marked by the lightly upheaved and broken surface. When working at a greater depth and in more compact soil the mole must dig its way and dispose of the loose earth by pushing it along the tunnel to an outlet at the surface through which it is thrust to form a mound similar to the "dumps" of that other great miner, the pocket gopher.

On account of this similarity in mode of life, moles and pocket gophers are sometimes confused by persons not familiar with the two animals. The resemblance ends in this apparent likeness, for the pocket gophers belong to the great order Rodentia, or gnawing animals, while the moles are of the Insectivora, or insect-eaters.

The superbly forested region inhabited by Oregon moles is so well watered that few places, even on high mountain slopes, are too dry for them to occupy. These animals are generally distributed, and their hills may be seen in the midst of the great coniferous forests as well as in the open valleys.

They are most abundant in open grassy areas, especially in meadows and in the bottoms of canyons and similar places, where the damp rich soil affords a plentiful supply of earthworms, grubs, and insects on which to feed. Like other moles, they lead lives of great activity and almost constant hard labor. During damp weather they work near the surface, but in dry periods as the upper soil hardens they

follow their prey to lower levels. A hard shower, however, always brings an outburst of activity as they reoccupy the upper soil and throw up a multitude of new mounds. They have the habit of regularly coming to the surface to hunt food during the night. This is no doubt coincident with the swarming up to the surface of earthworms on which the moles feed. At such times many are captured by owls, cats, and other beasts of prey.

The runways of moles close along the surface, shown by well-marked ridges, are for hunting purposes, and the lower tunnels, from which the earth in the mounds is brought, are for traveling and lead to the nest chamber. The deep tunnels of the Oregon mole sometimes extend considerable distances along fences, or other surface cover, which afford more or less protection. Such tunnels are a kind of highway often used by several moles and also by shrews and field mice. The system of tunnels of the moles over a considerable area often intersect and are used more or less in common. As a result more than twenty moles have been trapped at a single point in one of these underground roads.

They make an intricate system of many-branched tunnels, the courses of which are usually marked by series of mounds varying from four to ten inches high and five to twenty inches wide, and often scattered over meadows or other fields from two to six feet apart. Owing to the persistence with which the moles raise their mounds everywhere in the occupied parts of their territory, they have become a serious and costly pest. In meadows the knives of mowing machines are dulled by them, and in towns lawns are disfigured by their undesirable activities. As a consequence they have now fallen under the ban and are classed with other mammals which have shown their lack of ability to fit in satisfactorily with the changed conditions brought to their ancient territory by civilized man. Under natural conditions their activities were undoubtedly entirely beneficial.

They appear to have but a single litter of young, numbering from one to four, each year. These are born in March and grow so rapidly that by the last of May they are working in the tunnels and are scarcely distinguishable from the adults.

The recent discovery that the Oregon moleskin is valuable for its fur will give such an incentive to trapping that there is little doubt the boys of the State within a few years will reduce the numbers of the animal and thus control its injury to agriculture. The market for the skins appears practically unlimited, judging by trade reports, one dealer in Brooklyn stating that he dressed 4,000,000 imported European moleskins in 1916.

THE STAR-NOSED MOLE (Condylura cristata)

(*For illustration, see page 461*)

The star-nosed mole, known in parts of Maine as the "gopher," is peculiar among the moles in having a fringe around the end of its nose formed by twenty-two short fleshy tentacles. A less-marked character is in the proportionately long tail, which becomes greatly enlarged in fall and remains in this condition during the winter months. Otherwise the external appearance of this species is much like that of the common moles of America and the Old World.

The star-nosed mole is found from southern Labrador, the southern end of Hudson Bay, and southeastern Manitoba south along the Atlantic coast to Georgia and in the interior down the Alleghenies to North Carolina and to Ohio, Indiana, Illinois, Wisconsin, and Minnesota. Throughout this area it ranges irregularly and much yet remains to be learned about the details of its distribution and habits.

Ordinarily solitary, these moles at times are so numerous in limited areas that they appear to form colonies. Such gatherings probably mean an unusually rich feeding ground, which makes it unnecessary for the young to disperse to outlying locations, as is the habit of moles and most other mammals.

The star-nosed mole has a strong preference for damp and even marshy or swampy locations. It frequents low-lying meadows, the borders of streams, and grassy swamps, where its underground burrows alternate with open surface runways among grass roots and other matted vegetation. It spends far more time above ground than the other moles, and not infrequently swims among flooded cat-tails and other vegetation and in winter has been seen swimming under the ice.

Like others of its kind, this mole is amazingly powerful in proportion to its size. It persistently adds to its surface ridges, and in constantly extending its deeper tunnels must dig loose earth and dispose of it by forcing it up through an outlet to form the mounds which mark the course of its travels. Where the soil is loose it readily forces it aside with its compact body and paddle-shaped hands. In pushing up the little piles of earth and in the ridges raised when burrowing close to the surface it sometimes injures meadows and other cultivated land. Occasionally it wanders away from the fields and invades lawns and gardens, where the only injury it does is in the disturbance of the soil.

Its nests are compact little balls of fine grass, weeds, or leaves in dry underground chambers excavated in its burrows. The nests are a foot or two underground, but above the level of the water, sometimes under a stump and again in a knoll or bank. One nest containing five young was found in Maryland in an old woodshed under several inches of chips. This location and its choice of a site for its nest under a stump in a field or in a dry knoll are clear indications of a kind of intelligence which even the lowliest animals appear to have in caring for their young.

The star-nosed mole is full of the restless energy so necessary in a mammal which must come across its food by more or less haphazard tunneling through the soil. It is active both summer and winter. In dry weather as the

moisture near the surface decreases the soil hardens and earthworms and other subterranean life seek deeper levels. The mole follows them, only to return with them nearer the surface with a renewal of the moisture. In winter it sometimes comes out and travels slowly about on top of the snow, ready to burrow out of sight at once, however, at the sound of approaching footsteps.

The food of the star-nose, like that of most other moles, is made up mainly of earthworms, white grubs, cutworms, wireworms, and other underground insects. In captivity, before eating a worm or other flesh food offered, it first feels of it with the little raylike organs of touch on its nose. It is difficult to surmise the real value of these "feelers," for it would seem that the acute sense of smell so common to mammals should do better service.

Aside from its disturbance of the surface soil by its ridges and mounds, the star-nosed mole does no direct injury, and its life is largely passed in the useful task of searching out and destroying insects. Indirectly it causes some injury to root crops, plants of various kinds, and fruit trees, by providing tunnels along which meadow and pine mice travel to commit the ravages which on circumstantial evidence are charged to the mole.

THE COMMON SHREW (Sorex personatus and its relatives)

(*For illustration, see page 464*)

Many interesting small mammals are nocturnal or lead such obscure and hidden lives that they are rarely observed except by naturalists. Of these are the numerous species of shrews, which include the smallest mammals in the world. These tiny beasts all live among the vegetation and debris on the surface of the ground or in little burrows below. With the moles they are members of the order Insectivora and depend mainly on insects and meat for food. Despite their minute size, they are possessed of an indomitable courage and ferocity, which leads them without hesitation to attack and kill mice many times their own weight.

The genus *Sorex,* of which the common shrew is a member, is circumpolar in distribution, the various species ranging through England, the European mainland, Asia, and North America as far south as Guatemala.

The common shrew is a purely North American animal, occupying all the northern part of the continent from the Arctic shores of Alaska and Canada south to northern Nevada, South Dakota, Illinois, and Pennsylvania, and along the Allegheny and high Rocky Mountains to North Carolina and New Mexico. Its vertical range extends from the seacoast up to timberline in the Rocky Mountains.

The common shrew is the smallest of the mammals in all the northern parts of this continent, and one marvels at the possibility of such a tiny morsel of flesh and blood withstanding the rigors of the arctic winters. It measures about four inches in total length and weighs about forty-five grains; the body and tail are slender, the nose long and sharp, and the rim of the ears shows a little above the dense velvety fur. By these characters it may be distinguished from the larger, more heavily proportioned (and darker-colored) short-tailed shrews which abound with it in certain parts of its range. Its smaller size and grayish brown color are the main superficial differences between it and other American members of the same genus. The climatic differences in its wide range have developed several geographic races, none of which, however, show strongly marked characters.

This shrew appears to have a most catholic taste, so far as its surroundings are concerned, for it appears to frequent every type of situation where shelter and food can be found. It abounds among the peat beds and sphagnum mosses of the desolate barrens bordering on the Arctic coast, as well as amid the rotten stumps, old logs, fallen leaves, and other vegetable debris on the floor of the forests farther south. It will be found also in the rank matted vegetation about marshes, in old fields and occasional sphagnum swamps in the southern parts of its range.

The little tunneled runways of these shrews form a network in the beds of moss in a sphagnum swamp near Washington. In the forest the animals always seek the cover afforded by fallen logs, slabs of bark, or anything else that will give protection. On the coast of New Jersey they live so near the sea that an extra high tide forces them to mount the drift logs on the salt meadows for safety. They often make little burrows in the soft earth under the roots of a tree, a stump, or a log.

Their nests are small balls of dry leaves, grasses, or other soft vegetable material placed snugly under a log or in a hollow stump, burrow, or other good retreat, where they appear to have two or more litters of from six to ten young during the summer and fall.

As in the other shrews, the food of the common species consists mainly of insects, larvæ, worms, and obtainable flesh; but in winter and possibly at other seasons many kinds of food are eaten, including insects, meat, fat, flour, and seeds. During the years I passed at St. Michael, on the coast of Bering Sea, the beginning of winter always brought into the storehouses and dwellings a swarm of field mice, lemmings, and these shrews. The food requirements of all appeared to be the same, and all fed freely on the flour and other accessible stores. Dozens of the shrews were killed in the houses every winter.

Occasionally I caught and kept one captive for a time to observe its habits. It would be extremely restless and equally active by day or night. The small eyes appeared of little service, but the long, flexible snout was used constantly and served as the main reliance of the little beast for information as to the outside world.

Wherever they travel these shrews utilize the

runways of the field mice or other small animals and make little runs of their own only where necessary. Aside from a faint squeak, I have never heard them utter a sound, but other observers credit them with series of fine twittering notes apparently uttered as a song.

The common shrew is a solitary animal of so morose a disposition that if two are placed in a cage together they almost immediately fall upon one another with tooth and nail, and the victor devours the body of its companion at a single meal. The digestion of shrews is so rapid and the call for food so incessant that it requires constant activity to keep the demand satisfied.

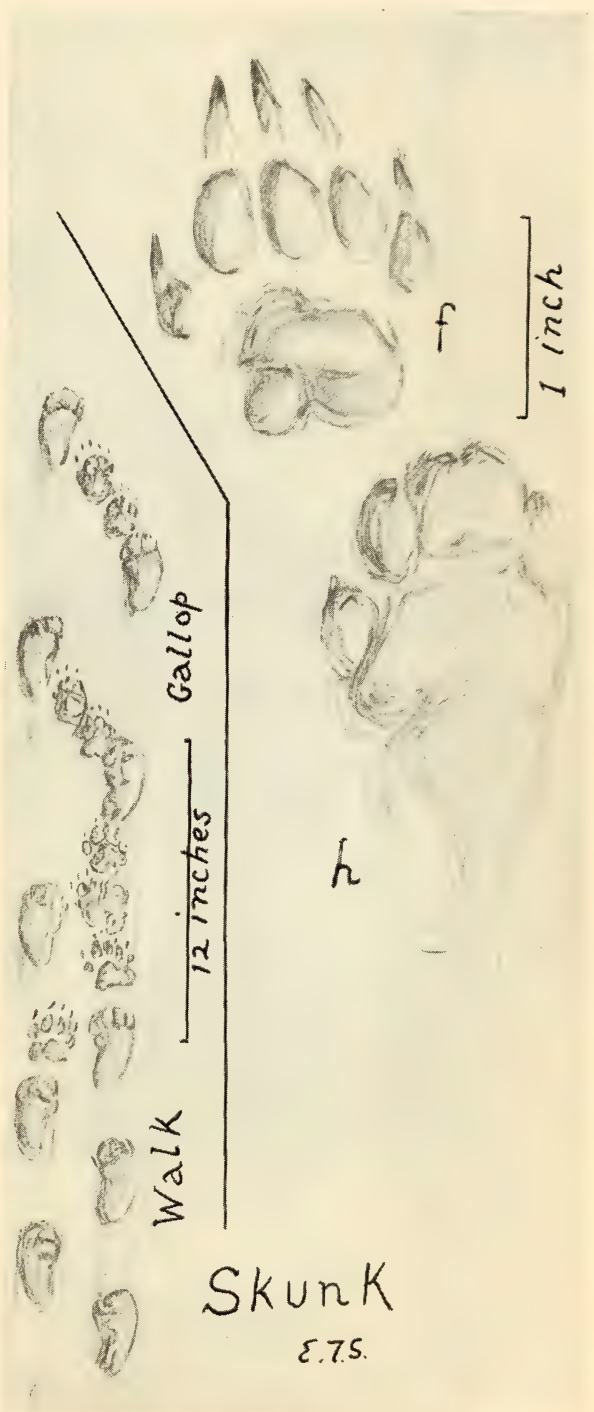
After the winter snow arrived in the North I found many tunnels of these shrews running just under its surface and raising it a little in a slight but distinctly rounded ridge. Such tunnels wandered widely and on the ice of the Yukon River I traced one of them more than a mile and repeatedly saw them crossing the river from bank to bank. It was surprising to note the ability of the little travelers under the surface to keep in so nearly a direct line for long distances.

At times these little adventurers make similar tunnels in the snow far out on the sea ice. The mythology of the Eskimos contains accounts of many supernatural animals which a lone hunter may meet and which have the power to do him deadly harm. Among these the "sea shrew" is one of the most malignant. Its appearance is described as exactly like that of the common land shrew, but it is said to live on the ice at sea, and if it sees a hunter to dart at him through the air, pierce the skin, and, after running all through the body with incredible rapidity, to enter the man's heart and kill him. In consequence of this belief the Eskimo hunters were in mortal terror if they chanced to encounter a stray shrew on the sea ice. I knew one hunter who suddenly meeting one on the ice stood motionless for hours until the shrew wandered out of sight. He then hastened home and all the other hunters agreed he had had a lucky escape.

THE SHORT-TAILED SHREW
(Blarina brevicauda and its relatives)

(*For illustration, see page 464*)

Several groups of species or genera of the little mouselike animals known as shrews are peculiar to North



THE TRAIL OF THE COMMON SKUNK

The hind foot of the skunk rarely shows the claws in the track. The diagonal set during the gallop is characteristic (see pages 456 and 477).

LITTLE SKUNK, POLECAT, OR SPILOGALE

This trail combines the characteristics of the skunk with those of a squirrel. At first it looks like the track of a stubby-toed squirrel, but the five-inch toe on the front foot is plainly seen. The frequent pairing of the fore paws is important. There is no tail mark (see pages 456 and 474).

America. Of these one of the most numerous and best known is the short-tailed shrew. It is a dark-colored animal much more heavily proportioned, larger, and with a shorter tail than the common shrew. Its fur is so thick and velvety that it is confused by many people with the mole, despite its smaller size.

The short-tailed shrews, sometimes called mole shrews, of the genus *Blarina* belong to a single species with several geographic races occupying eastern Canada and the United States, from Nova Scotia, southern Quebec, Ontario, Minnesota, and North Dakota southward to Florida and the Gulf coast as far as eastern Texas. Vertically they range from sea-level up to the tops of the Alleghenies. Another group of American shrews, containing numerous species belonging to the genus *Cryptotis*, occupies the mountains of the Western States, and ranges south to northern South America. In external form it is indistinguishable from the short-tailed species.

Probably no mammal is more numerous in the eastern United States than the short-tailed shrew. It occurs everywhere—in forests, in brushy areas, in old fields, and along grassy banks. Within the city of Washington it is common in Rock Creek Park, where it lives in covered runs which it makes among the grass and fallen leaves. These shrews drink frequently, and this may in part account for their abundance near streams or other water, although it may be the desirable moist soil conditions which draw them to such situations.

The runways of these shrews are scarcely half an inch wide, usually partly sunken in the mold or rotting surface vegetation. These are not made by digging, but by pushing aside the loose mold, and they cross and recross in an irregular network. They lead to the entrances to burrows which generally drop nearly straight down. The burrows are sometimes amid the leaves, but usually under the shelter of a root, stump, old log, or other cover. In addition to their own runways, the shrews make free use of the runs of meadow mice and even traverse the tunnels of the pine mice and moles in their restless search for prey.

Small rounded chambers opening off their underground runways are filled with fine grass, pieces of leaves, and other soft matter for a nest. One nest examined was made entirely from the hair of meadow mice, probably the spoils of war from the bodies of victims. As a rule, shrews are extremely unsocial, but a pair of this species is sometimes found occupying the same nest, no doubt a temporary arrangement. Several litters, containing from four to six each, appear to be born through the summer and fall, usually beginning in June.

While equally active by day and by night, the eyes of these shrews seem to be of little

use except to distinguish between light and dark, but their senses of hearing and smell are highly developed, as is also the sense of touch in their long hairs, or "whiskers," about the nose. In captivity an extreme sensitiveness is exhibited to sudden sounds, especially such as those of a bird's wings, indicating an instinctive fear born of age-long persecution by birds of prey. Food is located by smell, and as the flexible end of the snout is moved continually from side to side, odors are caught which may register conceptions as definite in the minds of these small animals as sight does in more favored beasts. All shrews are provided with musk glands and on account of these are apparently nauseous to most other animals, as they are rarely eaten by beasts of prey. These musky secretions must be of great service to facilitate them in locating one another.

Like other shrews and the moles, their digestion appears to be very rapid and they will eat two or three times their own weight in a day. This necessitates great activity on their part during much of the time in order to find the required food. They prefer insects and meat, but are practically omnivorous, feeding not only upon many kinds of insects, but on earthworms, slow-worms, sowbugs, snails, slugs, mice, shrews, and the young of ground-nesting birds, as well as such vegetable food as beechnuts, seeds, bread, and oatmeal.

The instinct of prevision against the season of winter scarcity appears to be developed in them, as one in captivity buried beechnuts in the earth, and they are known to store living snails in small piles and to gather disabled beetles in store-rooms in their tunnels.

The courage and blind ferocity of the short-tailed shrews when they are placed near captive mice far larger than themselves, is amazing to all who witness their encounters. They attack instantly, spreading their front feet to gain a firmer footing and moving forward in little rushes. Mice larger and much more powerful than the shrew are persistently attacked and, finally giving out, are pounced upon and the flesh torn from their heads and necks with ravening eagerness. One day a passing observer heard a loud squealing on a railroad bank where an examination revealed a short-tailed shrew dragging away a nearly dead pine mouse, though the mouse was much the heavier. The notes of the shrews are a fine tremulous squeak which becomes a longer, harsher, and more twittering or chattering cry when they are angry.

No cessation of their activity occurs in winter. When the cold weather begins many gather about barns and houses located near woods or old fields, and thus with the field mice take advantage of the garnered food supplies and shelter. Others remain in their regular haunts, where they frequently burrow long distances in the snow, making networks of tunnels and traveling long distances just below the surface, leaving little raised ridges like the track of a mole on the ground. Their journeys upon and under the surface of the snow appear to be in search of food, as they burrow down to old logs and stumps which make good feeding grounds. Their movements are very active, as they go about either at a walk or quick trot.

These fierce and truculent little hunters are wholly beneficial in their habits and should be encouraged in place of being killed on sight indiscriminately, as one of the ordinary mouse tribe.

THE RED BAT (Nycteris borealis)

(*For illustration, see page 464*)

Bats reach their greatest development in the tropics, where a marvelous variety of these curious mammals exist. To the northward the number of species gradually decreases, until eventually, in northern Canada and Alaska, a single species represents the group. The United States, occupying the middle latitudes, has a considerable number of different kinds. Some of these remain throughout the year, hibernating in caves during the period of cold, when insects are not to be had; others wing their way southward like birds on the approach of winter and return in spring.

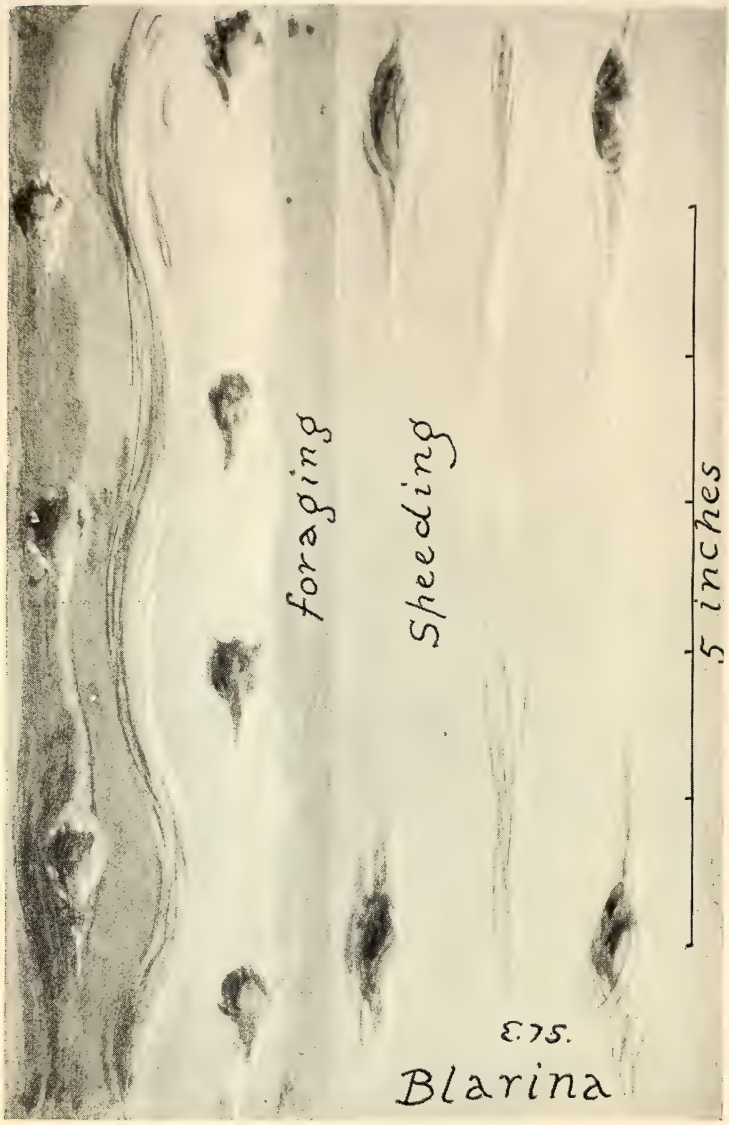
All bats are nocturnal, although individuals of some species occasionally fly about for a time by day and many come out just before or soon after sunset. In this country practically all species are insectivorous, but in Mexico and the West Indies many are fruit-eaters and a few true vampires or blood-suckers.

As a rule, bats are clothed in dull colors, but richly tinted coats give a few a more attractive appearance. Of these none has a more striking adornment than that presented by the soft covering of glossy orange-red fur of the red bat. Its large size, about four inches in total length, with a spread of wings amounting to twelve inches, combined with its color, suffices to distinguish it at once from any other northern species.

The range of the red bat extends from the Atlantic coast to the Pacific and from Ontario and Alberta in southern Canada south throughout most of the United States to the Gulf coast and southern California; also beyond our limits to Lower California and Costa Rica. The genus to which this bat belongs ranges more widely in other parts of North America; also to South America and across the eastern Pacific to the Galapagos and Hawaiian Islands.

The red bat rarely or never seeks shelter in gloomy caves and crevices, but hangs to the small twigs or leaf stems on trees and bushes in the full light of the sun. One observer in Texas on July 4 found four of them hanging in a cluster from a twig on a peach tree, with the sun shining full on them, although the temperature in the shade was 82 degrees Fahrenheit. I have found them in northern Illinois in the glaring sunlight of May, hanging from leaves in the tops of oak trees. This unusual tolerance of light in a member of the bat tribe is further shown by its habit of beginning to hunt through the air for insects earlier in the afternoon than other species in its range.

Long, narrow wings and swift, powerful flight



THE SHORT-TAILED SHREW, OR BLARINA

The curious grooved track in the snow with the tail mark is seen on the left (see pages 404 and 487)

characterize the red bats in the air. They have marvelous control in darting and turning here and there, and no birds, except possibly the chimney swifts, can equal them in their extraordinary gyrations.

Red bats are known to migrate from the northern part of their range in September or October and to return in May. They have been seen going south at Cape Cod the last of August and in September; and late in October Dr. E. A. Mearns has recorded great flights of them down the Hudson Valley, lasting throughout the day. That they share the vicissitudes of migrating birds is indicated by observation on the New Jersey coast of stray individuals coming in from the sea exhausted early on September mornings.

They are among the most solitary of their kind, usually being found hanging singly on a tree or bush, sometimes within a few feet of the ground. On occasion they gather in clusters as mentioned above, and in one instance in Maryland more than a dozen were hanging in a compact ball, which suddenly exploded into its winged parts when disturbed.

One of the most unusual characteristics of the red bat is found in the number of young it bears. Usually other species, except the hoary bat, have one or two young, but at varying dates between May and July each year the red bat produces from two to four, the average being three or four. The young when very small are carried clinging to the body of the mother in her flights. She continues to take them from place to place in this manner until their combined weight exceeds her own. The strength of the maternal feeling in this species is well illustrated by an instance in Philadelphia where a boy caught a half-grown red bat in a city square and carried it home. In the evening, three hours later, he crossed the same square, carrying the young bat in his hand, when the old one came circling about him and finally in her deep anxiety alighted on his breast. Both were brought in, the young one clinging to its mother's teat. The devoted mother received injuries when she was captured, from which she died two days later.

In the contact between mankind and bats, man, the invariable aggressor, finds the bats baring their teeth, biting viciously, squeaking, and behaving altogether like little fiends. A gentler side is sometimes exhibited, however, and one observer who caught a partly grown red bat found that it became tame, showed in-

telligence, and developed a friendly feeling for its captor.

THE HOARY BAT (Nycteris cinereus)

(*For illustration, see page 464*)

The hoary bat is a close relative of the red bat described above, but is larger, about five inches long, and, as its name implies, is of a different color. It is widely distributed over a large part of North America, where it is known to breed from Nova Scotia, Manitoba, and the southern shore of Great Slave Lake south practically throughout the United States. It is one of our larger species and is remarkable for its power and skill on the wing. The wings are long and narrow and carry their owner through the air in a bewildering series of swoops, curves, and zigzag turns remarkable even in a group of animals so notable for their powers of flight.

With the approach of cold weather the hoary bat migrates from the northern parts of its range to the milder southern districts. It is a late migrant, not leaving its northern home until the last of September or October and returning in May. Some individuals appear to remain in the North all winter, as one has been taken in Connecticut in December. In its southern flight it wanders as far as Jalisco, near the southern end of the Mexican table-land, to Lower California, and to the Bermuda Islands. To reach the Bermudas it is evident the bat must make a continuous flight from the nearest point on our shores of at least 580 miles—a good tribute to its wing power.

Like the red bat, it lives in the open, hanging from twigs and leaves in the tops of trees or bushes in the broad light of day rather than in the dark, stifling crevices where so many of its kind pass their lives. It appears to hang up indifferently on any convenient tree or bush, including conifers, aspens, or willows. During the day it has a curious lack of alertness, and as it is not rarely attached to low branches or bushes within a few feet of the ground it may be readily approached and taken in the hand. I once captured a fine specimen the middle of May, in southern California, hanging on a bush about four feet from the ground. It appeared to be sound asleep until taken by the skin on the back of the neck, when it became very much alive and, struggling in a fury, uttered grating shrieks of rage, baring its sharp, white teeth and trying desperately to bite.

Its food is made up entirely of insects, which it appears to hunt higher up than most bats, sweeping over the tops of the forest and in and out about the trees. It appears to be of even more solitary habits than the red bat and is nowhere so common. Another reason for our lack of information concerning it is found in its strictly nocturnal habits, for it rarely appears until shortly before the approaching night hides it from view.

The hoary bat shares with the red species the distinction of bearing from two to four young each year. The young are born in June and are carried attached to the underside of the mother's body until they become too heavy a burden. They hang to the teats with the greatest tenacity and apparently rely mainly on this hold to prevent being dropped as they are carried on the wild aërial hunting excursions. With the unusual fecundity indicated by the number of young, it is difficult to account for the scarcity of these bats unless their habit of hanging in the open, exposed to the elements and to other dangers, may cause a heavy mortality among them.

THE MEXICAN BAT (Nyctinomus mexicanus and its subspecies)

(*For illustration, see page 465*)

Reference has been made in several preceding sketches of this series to the mammals of tropical origin which have invaded our southern border. The Mexican bat is a notable member of this class. It differs in many curious ways from the bats with which it associates in temperate regions. It is smaller than any of the other three bats treated here and is strongly characterized by a flattening of the head and body which enables it to creep into a surprisingly narrow crevice in the rocks or elsewhere. The ears are broad and flaring and extend forward over the eyes like the visor of a cap, and the end of the tail is not confined within the membrane extending between the hind legs, but projects from it. Another pronounced characteristic of this bat and one highly disagreeable is the rank musky odor which it gives out. This pollutes the air about its harboring places, rendering it a most unwelcome guest.

Whoever has visited the Southern and Southwestern States or Mexico must have noted the offensive odor in many places about the verandas of houses and especially about old churches and other public buildings. This is the sign of occupancy placed on the premises by the Mexican bats, which, to the number of a few dozens or actually by thousands, as conditions permit, may lie snugly hidden in cracks and dark openings of all kinds about the roof and walls. No other bat in Mexico or the United States is provided with so strong an odor.

The Mexican bat is extremely abundant, probably exceeding in numbers any other species within its territory. It ranges throughout the tropical and lower temperate parts of Guatemala, Mexico, and across our border, throughout most of Texas, and east as far as Florida and South Carolina; in the West it also abounds both in town and country in the warmer parts of New Mexico, Arizona, and California.

Closely allied relatives of the Mexican bat abound throughout the warmer parts of Central and South America to beyond Brazil. The genus to which this species belongs is represented in the warmer parts of both hemispheres. It extends north in the Old World to southern Europe and also is found in the Philippines.

The abundance of the Mexican bat in some favorable places is almost incredible. At Tuc-

son, Arizona, I once saw them, a short time before dark, issuing from a small window in the gable of a church in such numbers that in the half light they gave the appearance of smoke pouring out of the opening. At times they occupy houses in such numbers that their presence and accompanying offensive odor render the places uninhabitable. At the town of Patzcuaro, near the southern end of the Mexican table-land, I saw two rooms in an old adobe house occupied by as many of them as could possibly hang from the rough ceiling. The owner considered their presence a valuable asset, as he collected and sold the guano for more than the rooms would have brought in rent. The bats congregate in even greater numbers in large caves. So numerous are they in certain caves in Texas that the owner reports an annual income of about $7,000 from the guano.

They are very plentiful by day in the thin crevices about the roof and walls of caves in the celebrated Ixtapalapa, or "Hill of the Star," beyond the floating gardens at the City of Mexico, and I also found them living in many of the marvelous ruins of Mexico, including Chichen-Itza, in Yucatan. Wherever they occur in numbers they may be heard frequently by day shuffling uneasily about and squeaking shrilly at one another.

When they first come out after sunset they usually fly away in a great stream, nearly all in the same direction, as though migrating. This course will probably be found leading to water, where they scoop up a drink from the surface before beginning their wonderfully erratic zigzags through the air in pursuit of insects.

From the colder northern parts of their range they migrate southward to milder climatic conditions or descend to lower altitudes. In Mexico, where they live up to above 8,000 feet altitude, they move down from one to two thousand feet. Their young, one at a birth, are born from April to May.

It has been claimed that the Mexican bat brings bedbugs to infest houses. This is untrue of this or any other bat. These animals have certain small parasites, some of which, resembling small bedbugs, have probably given rise to the belief mentioned. These parasites live only on the bats.

Within a few years considerable publicity has been given to the supposed possibility of utilizing bats to destroy mosquitoes and thus eliminate malaria from infested areas. One or more bat houses have been built at San Antonio, Texas, for the purpose of assembling bats in large numbers, and many untenable claims have been put forth concerning the benefit to be derived from their services. The Mexican bat is the species which abounds above all others at San Antonio and is the principal species which has occupied the bat houses near town. It is definitely known that bats often fly miles from their roosts when feeding and do not concentrate on any one kind of insect. Examination of the contents of the stomachs of Mexican bats shows that they feed on beetles and numerous other insects, but rarely upon mosquitoes. I have visited many Mexican towns and villages in which every house was haunted by numbers of these bats and where malaria was perennial. The evidence against these animals serving any useful purpose in checking malaria is conclusive.

It may be repeated here, however, that all of our bats are of high utility as insect-destroyers and should be protected. Among the many species of varying habits which exist in the United States, a few make their homes about houses in annoying numbers. In place of killing them to abate the nuisance, it would be better to exclude them from buildings by closing the entrance ways promptly after all have left in the evening, and thus by quiet eviction cause them to find abiding places elsewhere. The destruction of forests, and the consequent absence of the hollow trees where they formerly lived, is mainly responsible for bats and chimney swifts coming to houses for harbor.

THE BIG-EARED DESERT BAT (Antrozous pallidus and its relatives)

(*For illustration, see page 465*)

The marvelous variations in structure of the ears and other organs about the heads of insect-eating bats serve probably as microphones by which the flight of their prey may be detected and its direction located with instantaneous certainty. The beautiful accuracy with which this hearing mechanism works must be evident to any one who will take a position where he may have the evening glow of the western sky as a background for flights of bats. It is certain that the small and ineffective eyes these animals possess could never locate their minute flying game and enable them to secure it in the whirling, zigzag courses they pursue, often at a speed and under a control which few, if any, birds could rival.

The great ears of the big-eared desert bats illustrate one form of a highly developed hearing apparatus and give these animals a handsome and strikingly picturesque appearance. This character at once distinguishes them from others of their kind in the United States.

The distribution of this species lies mainly in the arid parts of the Southwestern States and Mexico. It extends from western Texas, southern Colorado, Nevada, and Oregon, south to Queretaro, on the Mexican table-land, and to the southern end of the peninsula of Lower California. The vertical distribution extends from sea-level up to at least 5,000 feet altitude.

By day these desert bats live in crevices and caves in cliffs, in old mining tunnels, hollows in trees, and in sheltered places about the roofs and walls of houses, barns, or other buildings. Their presence in dark hiding places may sometimes be detected by occasional grating squeaks. They appear to lack any musky odor which characterizes so many bats. About the 1st of June each year either one or two young are born, and for a time these cling to the mother's

breast and are carried during her swift flights in pursuit of insect prey.

Often when camping at desert waterholes, I have seen them come in just before dark to drink, scooping up water from the surface while in flight, and then circling back and forth over the damp ground at an elevation of a few yards for the capture of some of the insects common in such places. At such times, with the distant hills mantled with a deepening purple haze and the pulsating heat of the day replaced by the milder temperature of approaching night, these bats could often be seen sharply outlined against the rich orange afterglow of the departed sun. Here and there in the still air flickered and zigzagged multitudes of tiny bats, like black butterflies, and among them the occasional big-eared bats on broad wings appeared huge in contrast. Their wing strokes were slower and shorter than those of the smaller species and impelled them forward in a swift, gliding movement which gave their evolutions a sweeping grace beautiful to see.

In August several years ago, during a visit to the Indian School at Tuba, in the Painted Desert of northern Arizona, I found these bats living in considerable numbers about the buildings. Just before dark they swarmed out and hunted about the surrounding orchards and small fields. One evening my collector shot at one as it circled over a potato field in a small orchard. It continued its flight, circling low among the apple trees as though unhurt, when suddenly it dropped to the ground. Supposing the bat to be wounded, it was cautiously approached and covered with a hat, when, without a struggle, it permitted itself to be picked up by the nape. It then became evident that the bat was unhurt from the shot. The reason for its sudden descent was revealed in the person of a large, fat mole cricket (*Stenopalmatus fuscus*) which it was holding firmly in its jaws, and so ferociously intent was it in biting and worrying its luscious prey that it paid not the slightest attention to its captor. Finally it was killed by having its chest compressed and died with its bull-dog grip on its prey unbroken.

These bats, like the other members of the tribe in the United States, are fully as beneficial to the farmer as the best of our insect-eating birds and deserve equal protection in place of the general persecution from which they now suffer.

INDEX TO SMALLER MAMMALS OF NORTH AMERICA

TEXT AND ILLUSTRATION PAGES

	Text	Color illustration	Track illustration
Armadillo, Nine-banded	480	457	....
Bat, Big-eared desert	492	465	....
Bat, Hoary	491	464	....
Bat, Mexican	491	465	....
Bat, Red	489	464	....
Beaver, Mountain	427	432	....
Cat, Common	...	...	385
Cat, Ringed-tailed	482	460	....
Chipmunk, Antelope	443	437	....
Chipmunk, Eastern	447	440	477
Chipmunk, Golden	443	440	....
Chipmunk, Oregon	450	441	....
Chipmunk, Painted	451	441	....
Cony, Little chief hare, or Pika	392	409	....
Ferret, Black-footed	469	449	....
Gopher, Pocket	398	413	....
Hare, Arctic	389	408	....
Hare, Little chief, Cony, or Pika	392	409	....
Hare, Varying, or Snowshoe rabbit	387	405	388
Kangaroo rat	400	416	....
Lemming, Banded	401	417	....
Lemming, Brown	402	417	....
Marmot, American, or Common woodchuck	431	432	475
Marmot, Hoary, or Whistler	434	433	....
Marten, or American sable	473	453	....
Mink, American	472	453	482, 483
Mole, Oregon	484	461	....
Mole, Star-nosed	485	461	....
Mouse, Beach	422	428	....
Mouse, Big-eared rock	423	429	....
Mouse, Field or Meadow	403	420	393
Mouse, Grasshopper	418	425	468
Mouse, Harvest	415	425	....
Mouse, House	427	429	....
Mouse, Jumping	394	412	....
Mouse, Pine	406	420	....
Mouse, Red-backed	407	421	....
Mouse, Rufous tree	410	421	....
Mouse, Silky pocket	395	413	....
Mouse, Spiny pocket	396	413	....
Mouse, White-footed	419	428	470
Muskrat	411	424	467
Nature's wild folk	...	...	383
Pika, Little chief hare, or Cony	392	409	....
Polecat, Spilogale, or Little skunk	...	...	488
Porcupine	393	412	....
Prairie-dog	434	436	....
Rabbit, Antelope jack	384	404	386
Rabbit, California jack	385	405	386
Rabbit, Cottontail	390	408	390
Rabbit, Marsh	391	409	....
Rabbit, Snowshoe or Varying hare	387	405	388
Rat, Brown	423	429	472
Rat, Kangaroo	400	416	....
Sable, American, or Marten	473	453	....
Shrew, Common	486	464	....
Shrew, Short-tailed	487	464	490
Skunk, Common	477	456	487
Skunk, Hog-nosed	479	457	....
Skunk, Little spotted	474	456	488
Squirrel, Abert	462	448	....
Squirrel, California ground	439	437	....
Squirrel, Douglas	455	444	....
Squirrel, Flying	466	449	....
Squirrel, Fox	459	445	478, 479
Squirrel, Gray	458	445	....
Squirrel, Kaibab	462	448	....
Squirrel, Red	454	444	....
Squirrel, Rusty fox	459	445	478
Squirrel, Striped ground	438	436	....
Stoat, or Large weasel	469	452	....
Weasel, Large, or Stoat	469	452	481
Weasel, Least	471	452	....
Whistler, or Hoary marmot	434	433	....
Woodchuck, Common, or American marmot	431	432	475
Woodrat	414	424	....

THE NATIONAL GEOGRAPHIC WAR-ZONE MAP

THE MAP of the western theater of war appearing in this issue of the NATIONAL GEOGRAPHIC MAGAZINE fills a long-felt need. Existing maps available to the casual student of the war's progress have scales and letterings which preclude the use of more than half of the place names in the war zone. But it often happens that a little village of a score of houses, which has never attained to the dignity of mention on the maps of general circulation, figures more prominently in the news from the front than a place of several thousand population.

Therefore the National Geographic Society decided to bring out a map in which practically every name in the battle area, however unimportant, might have its place. The only maps extant answering to this demand are the big official maps of the French and Belgian Departments of War, made in sections and projected on a scale of approximately three miles to the inch. Of course, to reproduce them on that scale would make a map altogether beyond the compass of convenience. It would cover 3,960 square inches and would be too large even for a wall map, as one studying it would either have to get down on his knees or up on a stool to read it from top to bottom.

How to condense the information of more than 27 square feet of map into a little more than five square feet without destroying its legibility was the problem confronting those in charge of the undertaking. As the battle area is only about a hundred miles wide at the widest, while the battle line is some four hundred miles long, another problem was so to divide the line into two sections and so to arrange these sections that 400 miles of battle line could be put into a map on a scale of approximately seven miles to the inch and of convenient size.

Battle lines as of specific dates have been omitted because the line is always changing; the map showing it is out of date in a few weeks. But by reference to the inset map the lines in the fall of 1914 and the spring of 1918 can be fixed. By starting in at Dunkirk and underscoring each principal city along the battle line in red—taking Ypres, Arras, Bethune, Amiens, Montdidier, Noyon, Laon, Rheims, Soissons, Verdun, Lunéville, Nancy, Toul, etc.—the general trend of the line may be followed. If the reader will remember that the news speaks of this sector and that, corresponding usually to these principal names, little trouble will be experienced in locating places. For those who want to study the map in detail, however, an index has been prepared.

As the squares into which the map is laid off are ten miles each way, and therefore contain one hundred square miles of territory, the reader can easily estimate the terrain lost or won in any given drive.

In this map the aim has been to combine legibility with completeness, and except in one or two sections, where names were so thick that even with the small lettering used they could not all be put in, the reader will always find the place he is looking for. Fully 95 per cent of the names mentioned in the daily news appear on this map.

The excellence of the map is due to the patient perseverance of the Society's chief cartographer, Mr. Albert H. Bumstead, who met and overcame many unusual obstacles in the production of a readable map containing a maximum of information in a minimum of space, and to the unusual photographic work of Mr. Charles Martin, chief of the Society's photographic laboratory.

Those desiring the index can obtain it by remitting 25 cents to the National Geographic Society, 16th and M Streets. Washington, D. C.

Additional copies of the map can be obtained at 75 cents each (including index) and of a special edition, printed on linen-back map paper, at $1.50 each (including index). Foreign postage, 50 cents.

Additional copies of this May issue, postpaid, 75 cents each in the United States.

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THE NATIONAL GEOGRAPHIC MAGAZINE

COOTIES AND COURAGE

By Herbert Corey

Author of "The Monastir Road," "Shopping Abroad for Our Army in France," "A Unique Republic," etc.

The "cootie" is not a pleasant topic to write, talk, or think about; but the seriousness of this menace to the health and comfort of our soldiers—a menace which scientists are exerting every effort to minimize—warrants the publication of Mr. Corey's unexaggerated account of the chief pest of all fighting men.

LAST night I heard laughter as I stumbled along a dark street in a dark village in northern France. I say "dark," but the word does not properly set forth the conditions. There was no moon and there were no stars. It had been raining and in a few minutes it would be raining again. The street had once been paved—about the time of the Roman occupation, perhaps—and a few rounded cobbles were still imbedded in a soggy mud that sucked at one's boot-soles as one walked.

No light came from the windows. One knew that inside the houses American soldiers were gathered about the candles, reading or "shooting craps," or wondering why the Y. M. C. A. was not performing total impossibilities in getting its chocolate-and-cigarette-laden trucks over roads that were gummed and cluttered with the camions of an army in movement.

The windows were curtained, so that not the slightest gleam escaped. In this part of France the peasants favor solid wooden shutters outside the windows, and inside the soldiers had tacked up blankets. Hostile airplanes are always on the hunt for villages in which soldiers may be bombed. This particular hamlet was within range of the Germans' big guns and no chances might be taken.

WHEN AN AMERICAN "OUTFIT" ENTERS A TOWN

Only those who have been lost in the midst of a forest on a rainy night can properly appreciate the utter blackness of that street. I ran head-on into a soldier.

"Visibility low," he remarked, in grimly humorous quotation from the report often made by the aërial observers.

The laughter came from the one room in which the officers of the headquarters company were bedded. I knew that room. In it the beds were laid so thickly on the rough brick floor that they overlapped like shingles on a roof. Only the man who slept next the door could get to his bed without walking over the beds of the other men. All others walked over his bed in going and coming. They were distinguished from each other by the names of the owners chalked on the dingy wall.

When an American "outfit" enters a town in which it has been newly billeted, it finds that the billeting officers have preceded it. Upon the doors of houses

Photograph by Herbert Corey

A TYPE OF DELOUSING MACHINE NOW IN USE FOR CLEANSING THE CLOTHING OF OUR AMERICAN TROOPS SUFFERING FROM THE COOTIE PEST

The cootie is a hardy insect; it takes boiling water to kill it and prevent its eggs from hatching. But hot baths and sanitary laundries are rare luxuries in northern France and these big tanks are a necessary part of the equipment of the American Expeditionary Forces.

or the gates of courts such legends as this are written:

"Company I, one officer and 12 men."

Inside that house or that court or that barn an officer and 12 men of Company I are free to find such accommodations as they may.

Sometimes the officer sleeps between sheets and sometimes the men roll in their blankets on clean, sweet-smelling hay. Sometimes the lodgings are more primitive. Not long ago I visited a major whose bed was only divided from the bed of the household pig by a board partition, ventilated by huge cracks. Another officer shared a room with a sick cow. In another house the chickens and the men roosted together. No one complained; for this is war.

It was in burlesque of these chalked billeting orders that on the walls of the bedroom of the headquarters company had been written the names of the bed owners.

THE TYPE OF AMERICAN OFFICER IN FRANCE

I know them well. They average 24 years old, for I took a census of their ages. One owns rich mines in Mexico. One says he will be elected sheriff in his county in central Tennessee when the war is over. Another was an officer in the Philippine constabulary and resigned his commission to get into the greater game. One is a six-foot-four youngster from a clean home in Nebraska. He does not speak of his home, but one can always tell. Another was a Kansas City newspaper man, and another had been in business in Milwaukee when we declared war.

That is the sort of men they are—clean, lively, energetic Americans. I wanted to know why they were laughing, so I fumbled my way to a dark door and through a black hall and lifted a blanket curtain and stepped in.

"Thus," some one was saying in a pompous, professorial way, "we observe, gentlemen of the class in entomology, that when confronted by danger even the humblest—I might say the most despicable—insect manifests a marvelous intelligence."

The members of the class were standing on each other's blankets. A youth who had left college to enter the army was giving an imitation of the instructor he had evaded by going to war. Two men were seated on the floor. "Signals" was picking "cooties" from the seams of his clothes and depositing them on a space that had been cleared. "Stokes" was embalming them in drops of grease from a guttering candle.

A dozen white blotches on the worn red bricks told of the success of the pursuit.

HEROES WITHOUT GLORY

Perhaps the reader thinks there is something repulsive and disgusting in this tale of clean-minded young Americans picking lice out of their clothing and killing them by drops from a burning candle. Perhaps there is. Perhaps my mentality has been warped by almost four years of war. To my mind the men who can do this and still laugh—bearing in mind their rearing and the clean years of their youth—are almost as nearly heroes as those who "hop over" when the whistle sounds the zero hour.

The ones are called upon to keep up their courage under a day-long and night-long degradation—a constant, crawling, loathsome irritation—while the others spend themselves freely in one fine burst. I cannot distinguish between brave men.

I call them "cooties" as the soldiers do, and for precisely the same reason that they nickname these minor, or are they major? horrors of war. Only the surgeons and the surgical orderlies and the men who run the steam cleaning machines come out bluntly with the word "louse." They are practical men. Their business is to deal with human ills and weaknesses, and they are habitually pressed for time. Their talk goes straight to the point, like a probe. The poor devils who are lousy always shy at the word.

"COOTIES," "TOTOS," "CODDLERS," "PANTS RABBITS," OR "SEAM SQUIRRELS"

The American soldiers speak of the pest as "cooties." The French fighter talks of "totos" and the British tell of "coddlers." They know it is not their fault that they are infested, but the effect of years of civilian training persists.

Photograph by Herbert Corey

OBSERVING THAT WHICH IS NEXT TO GODLINESS

And here is a group of the doughboys waiting for their clothing, which is being treated for cooties in the delousing machine. The machine (see pages 496, 500, and 503) kills the insects and destroys the fertility of the eggs by subjecting them to the heat of live steam.

Photograph by Herbert Corey

AN AMERICAN ROLLING KITCHEN ON ITS WAY TO THE FRONT ON A RAINY DAY

Each company of 250 men has a mess sergeant and four cooks. Each cook has two helpers and four kitchen police. The "K. P.s" are seen standing at the rear wheels. It is their duty to find the wood and water and do the rough work. Note the tin hat slung to the collar of one of the mules.

They still feel, against all reason, that there is something shameful in their state. They try to assume a joviality they do not feel, and call the things "pants rabbits" and "seam squirrels" and speak of "reading their shirts."

"I'll meet you this afternoon," a noncom once told me, "down at Cootie Park."

Cootie Park was the grassy bank of a streamlet on which the sun shone warm. In the meadow was a flock of sheep guarded by two alert dogs, while the bent old shepherd carried the weaker lambs in his arms. Now and then he blew upon a brass instrument — half whistle, half squeak—and the flock and dogs obeyed his summons.

The disciplined sheep interested the boys immensely, as they sat there bare to the waist in the sunshine, going over their seams. Two discussed the shepherd and the sheep:

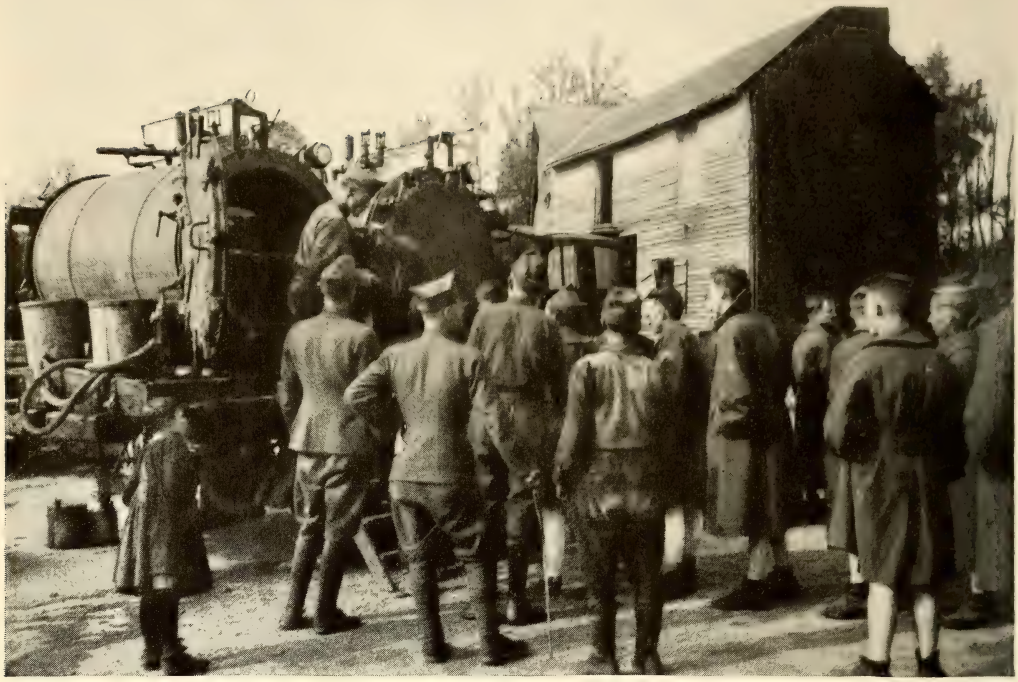
"Sure," one said, "he can blow every order we've got in the manual of arms. Last night I was watching him, and when it came time to start home he whistled 'Eyes right,' and they did."

TRUE MORAL COURAGE NEEDED TO BEAR THIS PLAGUE

This is not a pleasant recital, if one thinks in civilian terms of the louse as loathsome and suspects that the men who suffer from this plague are in some way to blame. At the very best it cannot be pleasant. But lately, since my own people have come into the war, and because I know them best and talk their language, I have begun to realize the moral courage that is needed to bear this plague without whining.

Many a man has told me that to be under fire would be a trifle if he could but be clean. Mud and thirst and hunger and cold can be borne with equanimity, but the louse carries the suggestion of degradation. Yet that, too, is sustained bravely.

"I have only known one man who cried because of the plague," a surgeon once told me. "That man went into No Man's Land on reconnaissance at night in as commonplace fashion as though he were taking the tram for the office of a morning."



Photograph by Herbert Corey

THE DOUBLE-BARRELED COOTIE CANNON IN ACTION

American youths waiting around while their cootied clothes are being cooked. As an evidence of the stress which General Pershing puts on cleanliness, a cable from the front announces that razors are now being issued to the enlisted men of the American Expeditionary Forces. Clean faces are adjudged to be an element in morale. In addition to a razor of the safety type, together with extra blades as required, each man is issued a tooth-brush, comb, hair-brush, soap, and towels. This is the first time in the history of our army that razors have been issued.

"I don't mind the nights on guard in the front trench," many say, "because the nights are cold and 'they' are quiet. But I dread the coming of the day, when I must crawl back into my dugout and try to sleep and know that I shall have to lie awake and feel 'them' crawl. 'They' become a torture."

Practically all of the men in the advance areas are lousy, according to a document that is accepted as authoritative. It is impossible to tell what proportion of the men in the rear and along the lines of communication and in depots are infested.

It is probable that the men in the French armies suffer to a like extent, for the conditions under which they live are identical with those of the other armies.

During the formative period of the American army in France the men were able to keep fairly clean—only fairly—but with the opening of the year's activity they were set upon the same footing as their allies.

HOW THE SURGEONS WORK AFTER A GREAT BATTLE

The great fear of the military surgeons is the time following a battle, when the field hospitals and clearing stations are swamped by a flood of wounded men lying grimly silent upon their blood-soaked litters. Then the surgeons work in teams, each operator being accompanied by his ether specialist and his orderlies and nurses.

They go from table to table swathed in white, their instruments freshly cleaned and sterilized and glittering, their cotton

gloves white and new. Other men wheel in the tables on which the wounded lie and wheel them away again when the operation is completed.

The operators go on without pause, never asking after the fate of those who have been operated on, never looking ahead at the line of waiting tables, until exhaustion stops them.

TRENCH FEVER AND TYPHUS TRACED TO THE LOUSE

Such a gorge of hurt men is the thought that haunts the waking moments and the dreams at night of every surgeon at the front.

But such days are rare, while every day the louse must be fought. It carries with it the threat of epidemic. In the eastern field of war the louse is a typhus carrier, and there is no known reason why it shouldn't carry typhus in the west.

Trench fever has been traced home to it. Until a comparatively short time ago this was a mystery, with its recurrent chills and fever and the semi-paralysis that is an occasional result.

It is definitely known that a form of itch is to be charged against the louse, and a lowering of morale and a lessening of the power of resistance is certainly produced by it. In some cases men have been rendered so nervous by prolonged exposure to the irritation of the louse that they have been made unfit for duty.

THE RAT AND FLEA PESTS

There are other trench pests, of course. Perhaps one hears more of the trench rat, for sufferers from rats are almost morbidly candid in relating their experiences. Rats can be disposed of, however. Trenches can be policed into cleanliness and officers can enforce the rules against leaving bits of food about.

Without food rats cannot exist, and, being highly intelligent animals, they do not attempt life in sterile surroundings. They may be dogged and catted and trapped. At the most, the trench rat is little more than an annoyance.

He does run over the faces of sleeping men, and they waken their comrades to relate the fact. They discuss the odor of the rat's feet and the uncanny coldness of them. He eats leather shoe-strings and bridles and sometimes nibbles on boots.

The flea is the rat's partner, and bubonic and other plagues have been traced to the rat-borne flea. The trench rat habitually grows to an enormous and unprecedented size, so that a cat must have an heroic soul to tackle one of them unassisted, but I have yet to hear a substantiated story of a man being bitten by a trench rat, unless that rat was cornered.

Sometimes one encounters a humorist who tells his story:

"I met a rat one night in the trenches by Zee-bray," said one man. "On the level, he looked bigger than a Great Dane dog. I stood there like a gentleman and waited for him to give me the right of way, but when he didn't, I just took to the parapet and let him go by. Sure, the Germans were shooting, but I didn't care. I'd rather take a chance with a Boche than with a rat."

THE FLY IS DANGEROUS AT THE FRONT

There is an odd insect known as the "spring tail" and many sorts of flies. Ordinarily the fly is dangerous at the front in precisely the same manner in which flies are dangerous at home, because he contaminates food.

There is a biting fly, however, which is especially prevalent in regions where there has been long-continued fighting and where the contending forces have not had an opportunity to clean up the battlefields. A variety of blood-poisoning has been traced to the bite of this fly.

But of all the vermin of the trenches, the chief pest is the louse. He is unescapable and ever present.

The primary reason is that the men have only intermittent opportunities to clean up. Theoretically, of course, the men of all armies are washed and dried and newly underclothed once a fortnight. Sometimes glad-eyed optimists clean up their men once a week.

THE LIFE STORY OF THE LOUSE FAMILY

Even if that were possible, the louse would not be disposed of. He would manage to cling in the overlooked fold

Photograph by Herbert Corey

PART OF A DOUBLE LINE OF MEN WAITING BEFORE A Y. M. C. A. TRUCK IN FRANCE FOR THE SALE OF CIGARETTES AND CHOCOLATES TO OPEN

The truck was two days behind time, because of road and other conditions, and the men had been chocolateless and cigaretteless for that time. The supplies are, of course, made available at the smallest possible cost. Tobacco is now being supplied to American soldiers as a part of the army rations.

Photograph by Herbert Corey

THE FRIEND-IN-NEED IN USE AT THE AMERICAN FRONT

Despite their discomfort and the disgust which they feel at being infested with vermin, a condition for which they are in no respect to blame, the American troops in France never whimper. With splendid fortitude they joke about that which cannot be helped. "I don't mind the hikes now," said one soldier, "for all I have to do is to sort of shoo my shirt along."

of a blanket or under the collar of an overcoat. And by and by romance would begin to sing in his blood, and he would meet a lady louse and set up housekeeping. Whereupon a whole cityful of younglings would appear, and the unfortunate who played the part of an unwitting host would go back to his moments of uneasiness during the day and his hours of sleeplessness at night.

But under army conditions the men are almost never given a chance to clean up so often.

Let me tell the story of the outfit I have been living with for the past few weeks, because that story is typical of a regiment which has had a fairly good opportunity to keep free of the pest.

For some weeks it had been kept in the trenches, one battalion at a time. The men "up front" had no chance at all to keep clean.

They did not even wash their faces. There is no water whatever in the trenches, except when there is too much water, none of which is fit for use. The little that comes to the men in line is carried in at night, in galvanized-iron containers, by the men who have been told off for that duty.

Usually the "carry" is a long one. One may say that it is practically never less than two miles, because of the German guns. The cans are unchancy things to handle, and only the water absolutely needed for drinking purposes is carried in.

DAYS AND NIGHTS IN THE TRENCHES

During their time in the trenches most of the men are on duty all night long. By day they are required to stay in the dugout, not only for the sleep they require, but to be out of sight of the enemy and out of danger from his bombs.

A dugout is, in nine cases out of ten, a mere dirt-roofed hole in the ground. Sometimes it is a luxurious one, with a board floor, on which the musty straw is piled. Sometimes an abundance of straw makes up for the lack of boards. Sometimes there is no straw.

It is rarely large enough to accommodate the men, and if it were large enough the chill of a damp hole, into which the sun never shines, forces them to lie spoon

Photograph by Herbert Corey

THE MASCOT OF THE MARINES, WHO MADE HISTORY AND WON IMPERISHABLE GLORY AT CHATEAU-THIERRY

This ant-bear has accompanied the soldiers of the sea from the tropics to Picardy

fashion, each wrapped in his blanket, each seeking the warmth of the other man to add to his own comfort. It is ideally adapted for the furtherance of all insect plagues. No matter how scrupulously scrubbed a man may be when he enters a dugout, he usually comes out lousy.

When the regiment of which I speak left the trenches the men got a chance to clean up. Two days is always required for that—if not more—because the first day is spent in resting. The men are exhausted by the long hours and the scant sleep and the nervous tension under which they have been living.

The officers saw to it that each man bathed and each man was given a fresh suit of underwear. Then the "replacements" came.

THE "REPLACEMENT" MAN A COOTIE DANGER SOURCE

A "replacement" is a man sent to a unit to take the place of one of the men the unit has lost. No matter from whence he comes, in a properly handled regiment he first goes into quarantine. A surgeon looks him over, to see that he is not suffering from a contagious disease. Then he is examined for "cooties."

If he has them he is sent to the guardhouse and kept there, not as a punishment, but to be sure that he does not spread his pests among other men, until he in turn can be bathed and newly outfitted.

"Tomorrow we hike" was the word after dinner one night.

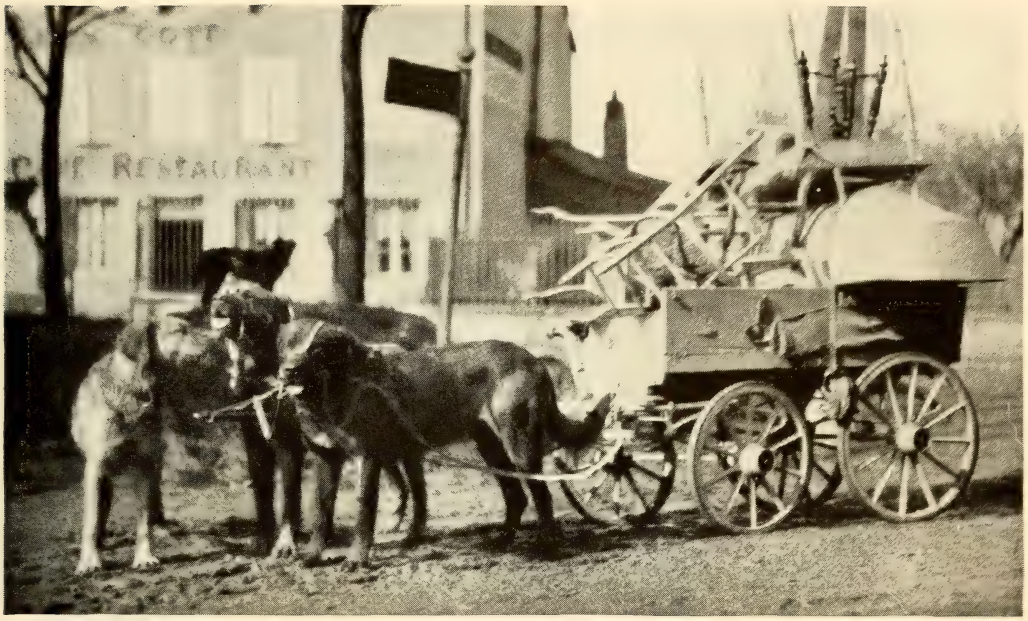
The regiment got under way at two o'clock in the morning, and for two weeks each day was too full to permit of proper cleanliness. Sometimes we hiked. Sometimes the day's program called for close-order drill, or special instruction for almost every available hour.

BATHING AN ORDEAL IN NORTHERN FRANCE

There were no moments left for bathing, and if there were, a bath in the cold water of the streams of northern France presents slight attractions to the man who has worked hard. There is always the hope that tomorrow may be a better day.

At last we reached a billet which was to be permanent for at least two weeks. It was only by diplomacy and unflagging industry that enough wood was found to keep the fires going in the rolling kitchens.

Hereabouts the peasants cook over fires that might almost be covered by a pocket handkerchief. As fast as the end burns



Photograph by Herbert Corey

HOW THE REFUGEES LEAVE A DEVASTATED TOWN IN FRANCE

A tiny dog-cart, piled high with odds and ends of household furniture, represents all the possessions saved by a peasant family which must start life anew in some distant section of France. So suddenly does the order of evacuation come that the civilian population seldom has time to make a choice of the things which can be saved.

off, the sticks are moved forward to present a fresh surface to the flames. The fires are all made of little twigs. Each year the peasants lop off the branches of certain trees and make them up into bundles for the winter's fuel. The season's provision for a farming family is unbelievably small.

"There are enough stumps in my old man's woodlot to boil soup for all France," a disgusted soldier told me one day.

"Cooties" can be killed by boiling water, if the water is hot enough and boiled long enough. The women of France rarely use hot water for the washing of clothes.

THE COOTIE IS A HARDY INSECT

In every village in the north there is a municipal laundry, in which the women kneel and souse the soiled linen in cold water which trickles into a tub, and then thresh the linen upon rough stones. The process is repeated until the cloth takes on at least the appearance of whiteness.

But this process does not kill the "cooties." The adult cootie is a fairly hardy insect and the eggs are extraordinarily resistant to rough treatment. The scientists who have been inquiring into the louse problem among the armies of the Western Front have found that clean clothes may be infested from these community wash-houses. The eggs remain upon the rough surfaces of the stones on which the linen is scoured and are taken up by the next armful of wet clothes.

If the scientists had their way they would either have the clothes of the soldiers washed by army specialists or by the soldiers themselves. They would forbid the men taking their clothes to the village *blanchisseuses*.

But the American soldier is a luxurious creature and has money in his pocket. He prefers to have his laundry done by the women, and he can hardly be blamed. If he were to do his own week's wash, he would be forced to do it at the same place and on the same stones over which the peasant laundresses work each day.

When there is no hot water to wash the men's clothing there is no hot water in which the men themselves may bathe. It is true that one sometimes finds a mu-

Photograph by Herbert Corey

THE SMALLER FRENCH VILLAGES ARE SERVED BY TRAVELING STORES OF THE SORT SHOWN HERE

Every necessity of French rural life is carried in them, from cap ribbons to plow-points. The American soldiers are looking for something to buy, for they have plenty of money in their pockets, but the contents of the traveling store rarely appeal to their tastes.

nicipal bath-house in the tiniest villages, but ordinarily the men are obliged to take their baths at the edge of a stream. Even when quarters are established for a stay of some time, it is not always possible to make better arrangements.

HOW THE BRITISH FIGHT THE COOTIE

The British take notably good care of their men in this respect, yet I found only a cold-water shower at a school for officers last winter. The water could not be heated, and so the Britons went under the splash and came out even pinker than when they went in. It sends a chill down my sensitive spine even yet to think about it.

"I got a hot bath yesterday," said the colonel's orderly. He was so extremely set up over it that I asked for details. He had built a small fire between bricks, fed it with bits of twigs he had collected and little parcels of straw and other odds and ends, and heated water in the cup of his canteen and used his mess tin as a bathtub.

Many cups of water were heated and he had bathed himself by fractional parts. But in the end he was entirely clean.

Not many men will go to such trouble, however, and in fact he secured an esthetic rather than a sanitary satisfaction from the process; for he had no way in which his clothes might be boiled.

In the month of which I am writing only a few lucky men of this regiment had hot baths. This includes the officers as well as the private soldiers. The men did what they could by cold-water baths and cold-water laundering to keep the pests down, and they have been aided by the insect powder which is distributed from time to time. Unfortunately it has not always been possible to get a sufficient quantity of that insect powder, because of conditions into which it is unnecessary to go.

A GASOLINE SPONGE-BATH FOR WRITHING SOLDIERS

If ninety-nine out of every one hundred men were absolutely free from "cooties," the hundredth man would infest the ninety-nine in a week's time under military conditions.

Sometimes unusual methods are resorted to. In a regiment largely made up of national guardsmen the hospital order-

lies took charge of one platoon which, through no fault of its own, had become infested.

At that billet there happened to be plenty of gasoline—a condition which rarely exists nowadays. The hospital man managed to commandeer a quantity. Then the men stripped and their clothes were literally soaked with gasoline.

An unusual spectacle followed. The hospital orderlies armed themselves with swabs tied to the ends of sticks. They dipped the swabs in open cans of gasoline. Then they swabbed the men.

"Ouch!" was the first remark made by each man as the gasoline filtered into the raw places where he had been scratching himself. He rarely paused with that exclamation; but the hospital crew was relentless.

"Stand up," they said sternly. "Whoa!"

It developed that they had immediately before been swabbing horses with gasoline for the same purpose and the words came naturally to their lips. The poor men being swabbed danced and swore, but they had to submit, for an under-officer supervised the process.

Physicians tell me that it is not at all certain that gasoline will kill the nits of lice, but the hospital orderlies had no doubt whatever as to the efficacy of their process. They manifested an artistic satisfaction in the swabbing, so that not a single nesting place in which eggs might be hidden was overlooked.

Later I asked the men who had been swabbed what the result had been.

"Fine," they said, their faces glowing. "It's a bully hunch. We're going to swipe some gasoline and go over ourselves now and then. It sure does kill the 'cooties.'"

HOW THE COOTIE STARTED

No army in the European field has a preëminence in cleanliness over any other army. The most that can be said is that some armies are worse than others.

It is assumed by those who have inquired into the subject that the louse obtained his foothold in the early days of mobilization, when Apaches from the slums and ruffians from the docks were herded into barracks along with men who had never known what it was to be anything but clean. So the louse spread and propagated until now its diffusion is general.

If every man and every stitch of cloth in every army were to be thoroughly freed from the pest today, in a week each man might be infested again. Enough "cooties" would be left over in unsuspected places to make a fresh start.

With all Germany's boasted ability to organize, the louse has fairly ravaged her armies. In the latter months of 1914 I visited a great prison camp near Berlin, in which 9,000 military prisoners of war were herded behind a high wire fence. They had no hot water and no soap and no bathing facilities. Those who wished might wash themselves in an iron trough, such as horses are watered at, which stood in the bleak openness of the prison parade ground.

FIGHTING THE PEST IN GERMAN PRISON CAMPS

Only those who have felt the moist cold of Germany penetrate through wool and fur to the very bone can realize the sturdy courage of the men who went to that horse trough day after day and did their heroic best to keep themselves clean.

Others sat in long rows on the paillasses of dirty straw in the cavalry stable tents which sheltered them, naked to the waist, while they attempted to kill the plagues that were driving them mad.

That was in 1914. I often wonder what has become of those men—if they have had the courage to live on amid such infernal torture.

The German armies were infested, so that one of the most popular charities in the Empire was the "Delousing Fund," which furnished various insecticidal compounds to the men at the front.

The Russian prisoners were infested to the last man—infested to a degree that no one unacquainted with army conditions would believe if I were to tell the unvarnished story—and through their plague brought the spotted fever to Germany in 1915. The Russians themselves were fairly immune, but it is said to have cost the Central Empires many lives before it was conquered.

Nowadays it is realized by the scientists who have given their time and

Photograph by Herbert Corey

AMERICAN AND FRENCH SOLDIERS PAYING A SILENT TRIBUTE TO THE AMERICAN DEAD

The flags which float above these newly made graves are the tribute of the Americans; the wreaths are the homage of their French companions

their blood to a study of the problem, that a high degree of heat and rigorous cleanliness are the only means by which the plague can be successfully fought.

N C I POWDER USED IN WAR ON THE BEASTIE

The N C I powder, supplied to all the armies, will free the men from the beastie if they have some little chance to keep clean while they are using it. One application is considered good for five days. It is made up of naphthalene, 96 per cent; creosote, 2 per cent; and iodoform, 2 per cent. It would not be favored in civilian circles, because the user of N C I advertises that fact to the most casual passer; but it does the work.

Another objection to N C I is that it causes severe smarting if used in large quantities; but the men seem not to object to that. The soldier who is thoroughly inured to war seems to care little for bodily pain. I have seen men at hard work whose slight wounds had been only partially healed, so that each movement must have been productive of pain.

The Englishman, if asked about it, grins and says that he must "carry on." The American says: "We've got to get through with it." The Frenchman assures you that it makes no difference to him.

There are other treatments. One is a vermijelli ointment, with which the men smear themselves almost from head to foot. A preparation of crude oil and soft paraffin melted together sets like a salve and is very useful when similarly used. A mercury ointment is likewise employed with success, but all these are merely temporary expedients.

It is when the men come into rest camps that the "cootie" is properly handled. Heat and hot water give temporary relief from the scourge. The method usually followed is that of the British army.

THE DELOUSING ESTABLISHMENT

The men enter the first room of a three-room bathing establishment. There they undress and hand their soiled clothes through a window to a receiver, who sends the bundle to the "delousing machine."

They pass into the middle room and take a thorough bath with plenty of soap

and plenty of hot water. A non-com is at hand to see to it that the occasional man who objects to cleanliness nevertheless follows the example of the others.

Then they move into the third room, dry themselves and put on clean clothes. These may not fit, but they are clean. The shirts, socks, and undergarments have been subjected to 215 degrees of heat in live steam for three-quarters of an hour, or sometimes are boiled for five minutes. The outer garments are thoroughly brushed and then ironed with a very hot iron down every seam and in every possible hiding place for the "cootie," or the eggs.

LOUSE HABITS DURING THE WAR

When it is not possible to arrange permanent cleaning-up establishments of this sort, the men are made to bathe as best they can, and their inner garments are steamed in huge horse or motor drawn "delousers," which hang about the rear of every army nowadays. Absolute cleanliness is not secured, but the evil is greatly reduced.

"The plague may at least be reduced to a minimum," remarks an English authority. "It is not so much a matter of pure science as of common-sense management."

Some interesting facts have been revealed by the scientists who have made an examination of louse habits during the war. One is that dugouts and buildings are never infested. The cold straw and the damp walls do not present any attractions to the bug. He does not even stay upon blankets any longer than is necessary. His home is in clothing that is being worn and from which he ventures to feed.

In an official document it is stated that in the British army 95 per cent of men who have seen six months' service are lousy; that the average number of lice per man is 20, and that 50 men to a battalion of 1,000 are dangerous carriers, each bearing from 100 to 300 lice.

A HIGH-RECORD SHIRT

One shirt was found to contain 10,428 lice, and more than 10,000 eggs were found under the microscope. This probably establishes the world's highest record, although nurses who served through the typhus epidemic in Serbia in 1915 told me that they had seen gray patches the size of one's two hands upon the bodies of men brought into the hospital. The pests were so thick in these patches that from a little distance they presented the appearance of a felted cloth.

The beast seems to lack intelligence, however, for in all the experiments no deliberate effort on his part to reach the human body has been observed. He is a creature of opportunity and environment.

Eggs have been hatched after a dormancy away from the human body of forty days, and single insects have lived and flourished on good feeding grounds for thirty days; but the longest period in which any survived separation from its human host was nine days.

NO ARMY IS CLEANER THAN AMERICA'S

Every effort is being made to keep the men of the American army free from "cooties," for the American surgeons and officers fully realize the danger that may be carried by the pests. During the early months of our army in France the French baths and the English delousing machines were used, but now we are getting baths and machines of our own.

Clean underwear is furnished the men at every opportunity, and they are given every possible insecticidal device, from the "cootie bags" of the French to the "navvy's butter" of the British. It is not too much to say that no army is cleaner than the American.

The fact that most impresses the observer, however, is the cheerful courage with which the American soldier is bearing this, as he is bearing every other danger and discomfort of the war. By preference he disguises his repugnance with a rough form of humor.

One man told me, as he left the trenches after a two weeks' stay, that he had "little cooties" feeding on the "big cooties" now, and another said he didn't mind the hikes, because "all I had to do was to sort of shoo my clothing along." They never whine. They say they have "cootied" or they have not and do not add a comment.

Perhaps that is not the courage that seeks a fleeting glory in the cannon's mouth, but it seems to me it is a fine courage just the same.

HOSPITAL HEROES CONVICT THE "COOTIE"

IT WOULD be highly appropriate if the United States Government were to confer a special decoration upon sixty-six young American soldiers who have displayed unspectacular, but unsurpassed, courage in France, a courage that dared wasting illness, in a hospital subject to the bombardment of Hun shells, in order that future millions who are to make their way from our shores to the battle front may be spared the suffering and the disabilities of trench fever.

The courage which these sixty-six boys have evinced differs greatly from that induced by the battle call which sends men shouting "over the top." In volunteering to undergo tests which have identified trench fever as a germ disease they knew what they were facing—months, perhaps a year, of illness, of voluntary imprisonment in a hospital ward, of removal from all the activities and the excitement of the soldier's life in a foreign land, and from the companionship of comrades in arms. They were, necessarily, men in perfect health, many of them wholly unaccustomed to, and therefore dreading, the strangeness of hospital wards, of surgeons, of medicines, of blood injections, etc.

THE INOCULATION TESTS

The knowledge which these heroic sixty-six, by offering up their virile bodies to a disease test, have enabled science to acquire may prove the determining factor in the world war, for it may mean the conquest of trench fever, just as the sacrifices of a smaller group of men 18 years ago enabled Walter Reed and his associates to identify the mosquito as the insect which carries yellow fever. Once the source of the contagion was discovered the fight against yellow fever was more than half won.

The experiments conducted on America's Sixty-six have fastened the guilt of contagion-bearing upon the body louse, the "cootie," of which Mr. Corey writes in the preceding pages.

The first question studied was whether this was a germ disease. No germs could be seen with the microscope, but the U. S. Medical Department knew that there are numerous germs which cannot be seen by even the most powerful magnification. Therefore this point had to be established by taking blood from men with the fever and injecting it into healthy men. Out of 34 such individuals inoculated with blood, or some constituent thereof, taken from seven cases of trench fever, 23 volunteers developed the disease. Out of 16 healthy men inoculated with whole blood from a trench-fever case, 15 developed the disease. These experiments proved that trench fever is a germ disease, and that the germs live in the blood of men so infected.

LEARNING HOW THE DISEASE IS SPREAD

The next question was, "How is this disease spread?" Naturally, the body louse was to be considered first. Large numbers of these were collected from patients with trench fever, and also some of the same kind were brought from England, having been collected from healthy men. The lice from trench-fever cases were allowed to bite 22 men. Twelve of these later developed the disease, while four men bitten by lice from healthy men remained free from the disease. Eight other volunteers, living under exactly the same conditions, in the same wards, but kept free from lice, did not develop trench fever. After blood inoculation the disease developed in from 5 to 20 days. After being bitten by infected lice the fever required from 15 to 35 days to develop.

With such data in their possession, the medical departments of the Allies have taken up the problem of the "cootie" in its bearing upon the supreme question of winning the war. Until recently the odious vermin have been considered only in the light of bodily annoyances to the troops, in some cases having a certain effect on their morale. Now, however, the battle is on in earnest to rid the men of the disease-bearers, for when a man falls a victim to trench fever he is, in the average case, unfit as a fighter for six months.

It is a simple problem in multiplication to appreciate how tremendously America's Sixty-six may have contributed to the power of our blows against the Huns by giving science the information which will result in keeping our soldiers fit for service.

A BATTLE-GROUND OF NATURE: THE ATLANTIC SEABOARD

By John Oliver La Gorce

Author of "Roumania and Its Rubicon," "The Warfare on Our Eastern Coast," etc.

THE operations of the sea assassins of Prussia on our eastern coast, in a futile effort to stay the mighty blow America is beginning to strike against despotism, brings into bold relief that ever-changing stretch of coastline we so proudly call our Atlantic seaboard, which the writer outlined in an article published in the September, 1915, issue of the Geographic.

As the crow flies, it is some sixteen hundred miles from the out-harbor waters of Eastport, Maine, to the key-guarded shallows of Cards Sound, Florida; but as the shore stretches southward, miles lengthen into leagues, rocky citadels give way to shifting sands, and both yield place to coral reefs.

He who would follow the foreshore from northern Campobello Island to southern Largo Key has a journey that while taxing his legs would certainly stir his soul, for in doing so he would traverse the length of a battle-front in the most ancient, the most far-flung, the most unremitting, uncompromising war ever staged between puissant forces of nature—the war between land and water, with the wind as a shifting ally.

This warfare, harsh in its local results, is yet one that by its analogies has comfort for suffering humanity in the present hours of stress and crisis, for the final results, however serious the momentary aspects, are beneficial to mankind.

Before visiting the various sectors of the seaboard battle-front to study the more intimate details of the war between the sea and the soil, let us endeavor to get a bird's-eye view of the great conflict that started long before man appeared upon the face of the earth, and which can only end long after the planet is no longer fit for his habitation.

Every coast-line on the globe, be it that of a great continent or a tiny island, is a theater of nature's struggle, in which the warring forces are marshaled; every rainstorm is a vast squadron of airplanes of the sea, a veritable Neptune's Escadrille, sweeping the shock troops across the No Man's Land of cliff, beach, and reef, onward to the very heart of the land forces' strongholds, the mountains, where they wheel about and launch a rear attack with swollen torrent, hail, and ice.

Each drop of water is indeed a soldier of the sea, doing its small part, as it descends with force, in conquering the hillside, and its drum fire is to be reckoned with, because each inch of rain brings down one hundred and thirteen tons of water upon every acre of terrain upon which it falls.

THE AIR FLEETS OF THE SEA

As the tiny soldiers concentrate first in rivulet regiments, then into mountain-torrent divisions, and finally into big-river armies, they madly charge the rocks and grind them to dust by attrition and carry the captive sands ever onward to the sea.

The vast forces of the sea which are sent out in air fleets beggar belief. The rainfall of the United States perhaps averages 30 inches a year. On that basis every acre of ground is attacked by three thousand tons of water. And the water armies, marching back to the sea as rivers, take along a hostage of well-nigh unbelievable proportions, since it has been estimated that they carry some twenty-five billion tons of captive material with them.

The prisoners of the Mississippi might be used for an example, because their aggregate volume is greater every year than the total amount of material removed from the Panama Canal from the hour de Lesseps turned the first sod to the glorious day Goethals pronounced it a finished undertaking, or approximately 506,000,000 tons!

It often happens, however, that the seemingly vanquished turn on their cap-

Photograph by Charles A. Harbaugh

A BELGIUM IN NATURE'S WARFARE: WOUNDED, BUT UNBOWED

tors just as they come down to the dead line of No Man's Land and succeed in saving themselves from the prison camps of the sea bottom.

In such cases they form themselves into river deltas, like those of the Mississippi, the Po, the Euphrates, and the Ganges, although our own seaboard captives are not so fortunate, since deltas are conspicuously absent from the river mouths of the North American Atlantic and Pacific coasts.

In the attacks of the sea upon the land via the air, it is the constant endeavor of the water forces to bring the whole dry land area under its liquid fist. If the sea ever succeeded in its program of world dominion, which includes dragging every mountain down and filling up every ocean trench with the material graded from the land in a leveling process, there would be a universal ocean nearly two miles deep over the face of the globe.

WATER'S ALLIES IN ITS AIR ATTACKS

The water has as allies ice and atmosphere in its air attacks upon the land. Seeking out the fissures in a cliff and filling them, the water waits until the frost comes and forms ice.

No giant of any age, no superman, imagined or real, ever put his shoulders against an object with such smashing invincibility as is evidenced in the forming crystals of a piece of ice, while the air, elusive, unsubstantial, as it may seem when compared with water, is yet no mean confederate, because with its power to attack through chemical transformation and its extreme mobility, it can work important results even in a brief campaign.

Yet more to the immediate point of this discussion is the frontal attack of the sea against the land. With wave and tide and wind and undertow, with coastwise current and ground swell, the sea pounds perpetually at the gates of the land fortifications.

Starting at Eastport, Maine, let us take a mental journey along the battle-front and watch the great drive of the sea and the defensive tactics of the land. On the northwestern shore of Campobello Island, that beautiful bit of British ground which forms the seaward wall of Eastport harbor, stands "Old Friar," a remarkable rock, isolated and solitary, alone with its memories of a bygone day.

It is but a different version of the "battle" rocks that dot the granite fortifications for many weary miles on this coast. These sturdy sentinels are isolated forces which have withstood the buffeting of the foe's advance and are the outposts of the land legionaries in their mortal combat with the wave army that sweeps the coast in relentless fury. Their supporting forces have fallen back, the watery foe has entirely surrounded them, yet boldly they defy his onrush and present an inspirational picture of adamantine resistance, as they break up the assault of the succeeding waves that rush against the main defenses.

Enduring, inflexible, they continue to hold where their weaker brethren yield territory inch by inch. No Ten Thousand Immortals, no Guard Regiments, no Macedonian phalanx, ever stood their ground more nobly than do the pulpit rocks of the Maine coast.

THE BATTLEMENTS OF THE MAINE COAST

We have not traveled far when we discover that the Maine coast is an unbroken series of steep battlements. Without power to advance, without mobility to shift their positions, these cliffs are destined to a defensive plan of campaign, while the waves possess initiative, and their generalship is of no mean order.

Breaking relentlessly upon the eternal rocks, the waters might still wage a vain war, did they not succeed in capturing from the cliffs stones and boulders which they use as projectiles when they return to the attack. Here hard, ungrained granite armor-plate stands in the path of the onrushing waves, with such undaunted and unconquerable strength that, smash as they will, hammer as they may, the waves retreat after their attack, powerless to entirely reduce the defenses.

Farther along is another great mass of similar material, and it stands with corresponding might against the sea. But between them there is a series of cliffs made up of softer rock—the old men and the young boys of the land forces. Their morale is not high, their strength is not great, and so they give ground.

The flanks hold, but the center yields,

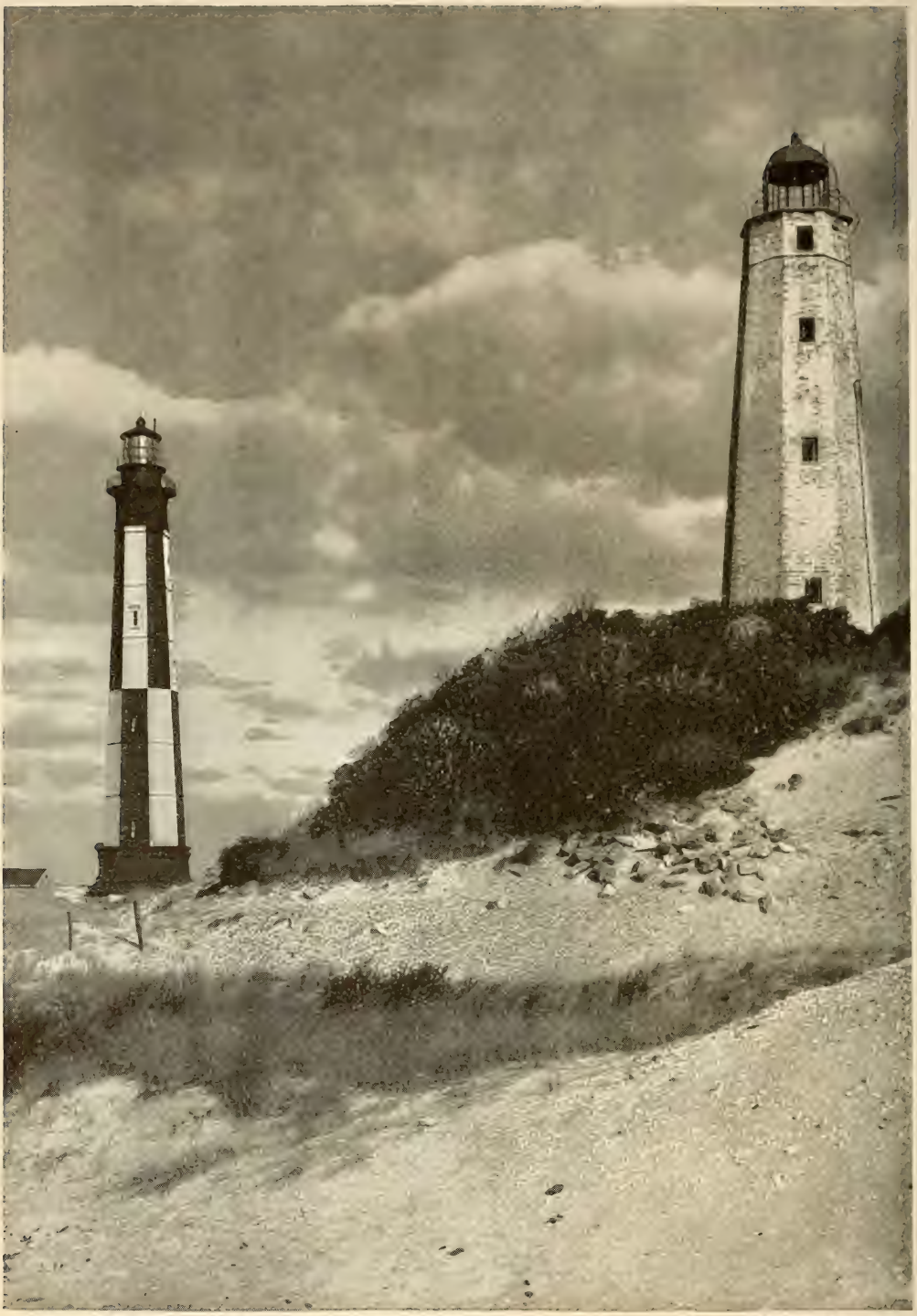
Photograph from R. H. Newcomb

"THEY SHALL NOT PASS"

Artillery of the sea shelling a Verdun of the shore: Pulpit Rock, Nahant, Massachusetts

Photograph from R. H. Newcomb

THE LAST STAND OF A LAND DIVISION SOMEWHERE OFF THE COAST OF MASSACHUSETTS



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FATHER AND SON: CAPE HENRY, VIRGINIA

The old light tower was the first builded by the American Government. The land army has defeated the sea at this point and driven it back nearly half a mile since the old light was established in 1791.

and alas, the untiring foe drives a salient into the lines of the land and uses the booty captured in his next drive. The salient is a bay or cove, and the wings are the headlands that bound it.

If one thrust be not too bitter, or if the retreating shore-line finally reaches a secondary line of defense on firmer ground, the enemy is held; otherwise it drives around the headland on all sides; and thus do "pulpit" or "chimney rocks" become lone outposts.

WHEN THE SEA ENCOUNTERS CROSS-FIRE RESISTANCE

It often happens, however, that when the thrust of the sea becomes too deep, the flanks of the attacking forces are exposed to the cross-fire resistance of the headlands, and finally reach a degree of penetration where they cannot maintain communications, and their attack comes to a standstill. In such a case we have a deep bay where the rushing waves of the sea lose their force before they sweep the inner shore-line.

One does not have to study the warfare waged by the sea very long before discovering that it not only uses "pincer" tactics, but that it also makes use of mining operations. Sometimes it finds that its most powerful onrushes are dissipated by the resisting power of a great headland, as the dew is dissipated by the morning sun or the darkness by the light of day.

With boulder and shingle the waters drive furiously at the base of the cliff, tearing away its foundations inch by inch and foot by foot until a soft spot is uncovered, and the sea enemy finally undermines entirely the great structure of defense. Then with the hydraulic pressure of an imprisoned wave it heaves forward, and the rocks above have no alternative but to tumble helplessly into the maw of the liquid host, to become projectiles in the sea's further assaults.

Often, too, the rushing waves find a weak link in the armor where one ledge of rock overlies another, with gravel or clay between. Yard by yard they wear out this grouting material, and a sea cave is the result.

The ledges which constitute the roof and the floor, respectively, have a dip toward the sea, and as the waves rush in they come nearer and nearer to the surface, until finally they break through at some joint in the roof, and we have the spouting horn—a trumpeter of Neptune who gives the gage of further battle with each flooding tide.

At still other places the waves drive back the softer shore and bare a long stretch of adamant on each flank. And then it comes to a spot in this flinty headland that is weak, and cuts its way through, making a graceful arch of a wonderful, wave-hewn natural bridge.

The tremendous power of the sea in utilizing the boulders it has wrested from the land in its return to the attack surpasses belief. Huge rocks, weighing seventy-five tons or more, have been moved by the power of the waves.

THE 42-CENTIMETER SHELLS OF THE SEA

Driving the big boulders up against the cliffs as though from a giant catapult, these 42-centimeter shells are finally worn down into cobble-stones, then into pebbles, then into sand, and at last into silt, which, caught up by the undertow, is borne along and out to sea, a bit of land forever in the prison-camp of the ocean.

As a result of the terrific grinding of the glacial ice of ages agone and in the following centuries under such methods of attack as have been broadly sketched, the Maine coast beyond Portland has become a series of gulfs and bays and headlands, with islands and rocks without number as the observation posts and first-line defense against the sea.

From Portland to Newburyport the bold cliffs gradually lower their towering forms and beaches and broad bays appear (see page 523). From Newburyport to Woods Hole is about eighty-five miles in a bee-line, but if you follow the shore around Cape Cod Bay and down along Nantucket Sound it is some three hundred miles. In that stretch of coast-line one might see fairly good types of all the shores from Greenland to Florida. There may not be fiords like those of the far north or swamps like those of Virginia, Georgia, and Florida, but there are enough shore-line features to fascinate any pilgrim who would wander that way.

Photograph by Carl J. Lomen

AN INNOCENT BYSTANDER CAUGHT BETWEEN THE BATTLE LINES

Photograph by H. C. Mann

OBSERVERS ON THE BATTLE-FRONT OF NATURE'S WORLD-OLD WAR: OFF THE VIRGINIA CAPES

Photograph from M. Rosenfeld

A NEUTRAL OBSERVER SURVEYS FROM ALOFT THE ETERNAL CONFLICT OF THE LAND AND THE SEA FORCES

A GIBRALTAR OF THE AMERICAN SEACOAST

North of Gloucester lies Cape Ann, with her pocket beaches. Here the waves run high and dash themselves with unpitying force against the solid old rock; but she holds firm, a Gibraltar of the American seacoast, guarding the outer approaches to Boston, as the wonderful British fortress has stood watch and ward in the path of the invader of the Mediterranean. So wild is the sea here that it is said that a sharp-angled fragment of stone as large as a steamer trunk is often worn as round as a tennis ball in the course of five years.

Many a brick and coal laden ship has perished upon such shores as these, and their scattered pieces of cargo have been ground to bits under the incessant hammerings of one another under the urge of the waves.

Marblehead, on the northern shore of Massachusetts Bay, is worthy of its name, and often the sea resorts to unusual tactics in trying to conquer it. Shaler, the well-known authority on geology, tells of witnessing an attack in which the sea used seaweed as its ammunition train. Sometimes these plants grow in shallow waters and wrap their roots around boulders on the floor of the ocean. Then, as the surging sea rolls in, it lifts the seaweed on its buoyant bosom, and the plants in their turn tug at the rocks which their roots enmesh, until finally the boulders are lifted clear of the bottom and carried along into the maelstrom of attack.

It is too hard a struggle for the seaweed, which is quickly torn asunder, but the stones are driven up to the attack again and again. As much as ten tons of these seaweed-borne rocks are sometimes cast up upon a quarter-mile stretch of shore-line by a single storm.

COMMUNIQUES OF NATURE'S WARFARE

Farther south, on the northern wing of the Atlantic battle-front, lies Lynn, and in the sea below Lynn lies Nahant Island, which bids us hope, for here at last the sea has lost the initiative, the land has assumed the offensive, and in an inspiring counter-attack is demonstrating its ability to give blow for blow and to match maneuver against maneuver.

Indeed, here for the first time we are to learn, in Nature's War Communiques, that the hardest rocks of the northern coast are more yielding than the softest sands of the southern waters and, in spite of local engagements fought with fluctuating results in this or that sector, as a whole, the land is holding its own from Lynn to the silver sands of Alton Beach at Miami.

In the counter-attack in the Lynn sector the land has built up a sandy beach between Nahant Island and the mainland.

Passing the Boston sector, where comparative quiet has reigned for some time, midway between Plymouth and Barnstable, where Buzzards Bay on the south and Barnstable Bay on the north have long seemed to conspire to tear off the "bare, bended arm" of Massachusetts, as Thoreau called Cape Cod, we come to the Cape Cod Canal. According to British charts in the Library of the United States Coast and Geodetic Survey, thought to date from 1715, there was once a sea-cut channel through that neck, and Cape Cod was an island, not a peninsula. Here, again, the land won out in after years and tied an island to the mainland.

ICE AS A LAND ALLY

The Cape Cod Peninsula affords an illustration of how the ice in geologic times came to the aid of the land in its war against the sea. Once glaciers swept down from Labrador and Maine and deposited vast quantities of clay and boulders on the floor of the sea, making a great breakwater to the east of what is now Cape Cod Bay. This obstruction forced the sea to give up the stores of sand it was carrying, and with this material the breakwater gradually wrought itself into a peninsula.

Passing around Cape Cod's two shorelines, inner and outer, one comes next to Chatham, at the elbow of the outer shore. Here the sea is once more on the offensive, driving forward into the shoreline at the rate of a foot a year.

South of Chatham is Monomy Point, called by De Monts, the French explorer who nearly came to grief there in 1605, the "graveyard of ships," a reputation it has lived up to for three centuries and better. Looking southward across the

Photograph by George R. King

WHERE PRISONERS OF WAR ARE FORCED TO FIGHT THEIR BRETHREN

A typical sector near Highland Light, Massachusetts, where the sea enemy uses captured boulders, torn from cliffside defenses, as projectiles with which to batter down the ramparts. Note the prisoners "left upon the wire" at the beachline.

eastern entrance to Nantucket Sound, one sights Nantucket Island in the distance. On the south side of this island the retreat of the cliffs is often as much as six feet a year.

Further to the west lies Marthas Vineyard, also an outpost of the land. Here there are rearing ramparts of rock a hundred feet high, but even they cannot entirely withstand the incessant attacks of the indomitable sea.

To the southwest of Marthas Vineyard lies the desolate island of "No Man's Land," which is well worthy the name it bears. Gradually the sea is tearing away its vitals, and it is predicted that by the end of the present century it will disappear beneath the waves forever.

In the case of the Cape Cod Peninsula, we saw how the land had used the ice of geologic times as its ally against the sea, but when we come to Long Island

AN OBSERVATION POST ON THE FIRING LINE

The sea makes a desperate attempt to gain a foothold near Portland Head Light, Cape Elizabeth, Maine, but with little success

there is a different story. Here the ice negotiated a separate peace with the sea, and, sweeping eastward across New York, scooped out what is now Long Island Sound, thus enabling the enemy to isolate the island entirely from the mainland.

WHEN THE LAND ASSUMES THE OFFENSIVE

On the south coast of Long Island we find beaches and shifting sands. Here again we get into more hopeful territory, for the land always has an upbuilding Oliver for every down-tearing Roland the sea may have to offer. From Shinnecock Bay to Fire Island, a rampart of sand some 40 miles long has been thrown forward off the real shore-line, and the sea, pounding against this in its maddest fury, encounters a buffer that throws it back a helpless and exhausted foe. Moreover, the sea is compelled to surrender captive sands taken up elsewhere, and these are re-equipped and put into the front trenches of the island's south-shore defenses.

Farther west on Long Island lies Rockaway Beach, the advanced line of defenses which the land has been throwing out to thwart the attack of the sea at the apex of the Jamaica Bay salient. What was once Pelican Beach has all but disappeared and what is left of it is now known as Barren Island. But Rockaway Beach has gained ground westward as fast as Pelican Beach has been driven eastward, and has now all but landlocked Jamaica Bay and its islands. It advances at the rate of two feet every three days.

SANDY HOOK AN ADVANCE GUARD

On the Jersey Coast, Sandy Hook stands out as an advance guard of the forces of the land, determined to cut through the line of communications of the sea in its drive into the Raritan Bay salient (see map, page 535).

Photograph by H. C. Mann

A "TANK" ADVANCING OVER A FOREST

Sometimes, when the wind acts as an ally of the land forces, a heavy tribute is exacted from the sea, from which huge sand ramparts are builded. Often these dunes, like great "tanks," become insubordinate and march inland, engulfing forests and even villages en route.

Photograph by William Reid

"STAND TO ARMS"

There is little rest given the grim defenders of such a salient, for here the enemy force their prisoners, torn from cliff and beach, to advance with them in the wild assault

Photograph by H. C. Mann

MOONLIGHT ON THE BATTLE-FIELD

Between the tides of attack a brief truce takes place between these world-old antagonists, but, as is the case in any undecided war with an unscrupulous enemy, it only means time in which to prepare for further attack at a later hour.

When there is a deeply indented coastline, the ocean currents paralleling the shores refuse to follow the indentation and cut straight across. Striking deeper water, they slow up and deliver from bondage the captive grains of sand which momentum has enabled them to carry along.

Eventually these grains grow into a high submarine ridge, which holds up the onrushing waves and forces them to give up a sand toll as they pass. Having gained courage in its size, the ridge makes a sally from the surf and becomes a full-fledged spit, or hook.

Sandy Hook is a splendid example of this method of the land in invading the dominions of the sea. It very frequently happens that the spit marches on until it reaches across the bay area and captures the entire water army within the salient. Then science decorates it with a *croix de guerre* and gives it a new name—it becomes a bar.

The captured waters of Tisburg, Oyster, and Herring ponds, on the southern shore of Marthas Vineyard, afford an excellent example of the conquest of the sea by a spit. But the fortunes of war often change, and the Marthas Vineyard Bar, once forcing a retreat of the open sea, is now in turn being driven steadily back. It is believed that the coastal edge at this point is a thousand feet from where it was when first seen by a white man.

WHEN THE SANDS ARE LED CAPTIVE

The Jersey coast is full of classic examples of the war between the land and the sea. Here are no towering ramparts, with frowning walls, that seem to defy all the armies with which General Neptune can attack them. Nay, rather, here the land forces have camouflaged their strength, and have entrenched themselves behind barriers of sand.

At Long Branch one may watch the shifting fortunes of the battle. Here, in spite of the most elaborate system of breakwaters man has erected, the shoreline is being led captive inch by inch. But the prisoner sand does not remain in captivity. As it is being escorted back of the lines it makes a successful dash for liberty and rejoins other land units north and south of Long Branch and aids in a counter-attack in those neighborhoods.

It is hard to visualize the full meaning of the conflict's swing until one views the battle-field from the observation tower of history. A few feet won or a few feet lost in a year seem insignificant. But generations are merely short-lived seconds ticked off on the clock of geologic time, and one needs the sweeping view of centuries to appreciate it all. On the New Jersey coast we get a little of that.

Prior to the War of 1812, Old Cranberry Inlet was one of the best havens of refuge on the eastern coast. It was a safe harbor for American privateers lying in wait for enemy commerce. But one night the sea made a heavy concentration of forces and staged a night attack of particular fury, broke down the defenses, and shifted the whole channel a mile to the northward.

SHIFTING OF LAND RESERVES AT ATLANTIC CITY

In the vicinity of Atlantic City the sea is ever striving to gain a foothold; but at present the best it can do is to force a shifting of land reserves from one side of a salient to another. In a few years it took off some 76 acres of ground from the neighborhood of Maine Avenue and forced most of it around to the lee of the point at Ohio and New Jersey avenues.

The pounding power of the waves when the sea is staging one of its major attacks is hard to picture by those who have visited the front-line trenches in bathing suits and have seen only a quiet sector. But when the breakers rush forward at a height of 10 feet or more, in serried ranks, striking from four to six majestic blows a minute, one does not wonder more at the vastness of the sea's reserves than he does at the land's powers of resistance.

SUBMARINES EMPLOYED BY THE SEA

The sea is thoroughly modern in its methods of warfare, even employing the submarine. As the waves sweep inward and break upon the shore, their waters must have some egress back to the deep. If they tried to go back as they came they would create confusion in the onsweeping forces behind them. To obviate this,

Photograph from J. E. D. Graves

A ROYAL BATTLE-GROUND: ORMOND-DAYTONA, FLORIDA

Here the White Horse Cavalry of Neptune make a charge twice daily over the most perfect beach in the world, from three to five hundred feet wide, on a front of about thirty miles. "The Silver Sands of Ormond" is no empty figure, because for ages the shells of the coquina clam have been ground under the heels of Neptune's charging horsemen until they have become fine sand. As soon as the foam-flecked forces fall back, the silvery sand settles down into a surface as level as a floor and almost as hard as asphalt, making one of the finest automobile speedways in the world, which is always kept in order by the tides.

they submerge and return along the bed of the beach. Here they constitute the undertow, an undersea current equally as reckless of life and the rights of noncombatants as a Hun U-boat itself.

It is by this route that they lead off many of their prisoners and drown them beneath the waves of the sea. Ten thousand banks on the bottom of the deep are cemeteries peopled with the worn and wasted sands of the seashore which were carried there by the undertow.

If the sea in its warfare against the land sometimes ruins a haven of refuge, as it did when it broke through the lines of the land at Old Cranberry Inlet, previously cited, at other times it is compelled by the land to create such a haven.

Off the Maryland-Virginia shore lies the long, barrier-like island of Assateague. Once the seaward southern point of this island was only a bare lip. Gradually, however, the land began to force the sea to give it sand, and with this it has built a fine hook behind which many a mariner seeks safety from the fierce nor'easters that sweep these coasts.

From 1908 to 1911 this invasion of the sea by the land went forward at the rate of 200 feet a year. But latterly it is following the usual course of offensives and is now advancing at the rate of only 100 feet a year.

ANOTHER ALLY OF THE SEA IN THE VIRGINIA CAPES REGION

When one comes to the Virginia capes and studies conditions there, it is found that in times past the sea had another ally, of which no mention has yet been made—subsidences. In a bygone age the Susque-

Photograph by James Burton

ON THE WIRE: NO MAN'S LAND. WHAT SOMETIMES HAPPENS WHEN MAN DEFIES THE WARRING ELEMENTS

The sun is munition maker for the sea. Every day it sends to the earth enough heat to melt a cake of ice 5,000 feet thick and as large as the State of Massachusetts, as much heat in an hour as the fires of all Christendom have produced in a thousand years. This heat is the high explosive that puts the fury into the storm that drives the projectile waves to the attack.

Photograph by William Reid

BARRAGE FIRE

Again and again the regiments of the deep advance to the attack with the wind ally behind them to whip the wave crests into stinging shrapnel

Photograph by J. Manning McLeod

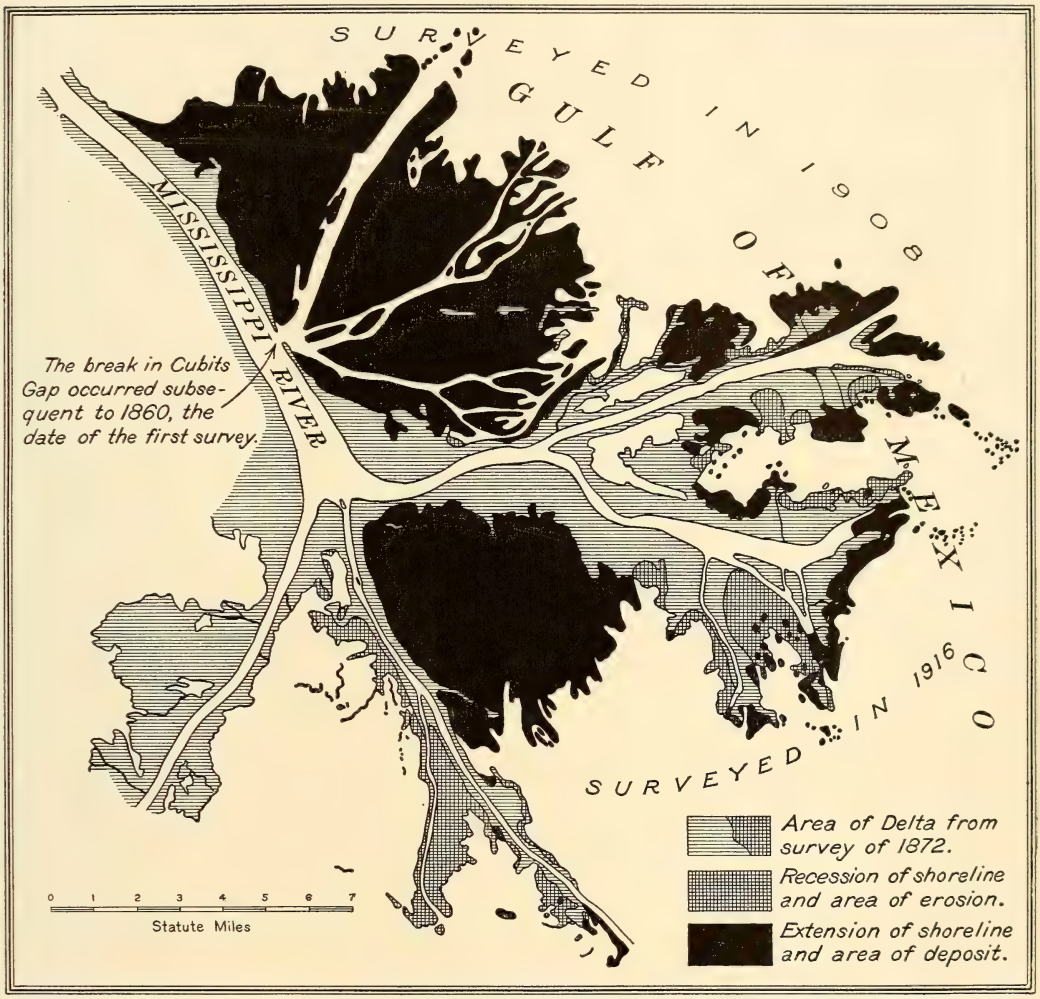
SUNRISE NEAR NORFOLK

The quiet waters of Norfolk's harbor have for nearly a century proved a welcome haven to ships from every out-of-the-way corner of the world; here the antagonists of the universe seem to have established a sort of unspoken peace

Photograph by H. C. Mann

A CAMOUFLAGED TRENCH

The enemy's thrusting-point is frequently changed and heavy artillery is superseded by strategy, during which period the land regiments endeavor to strengthen their fortifications by utilizing plant life to cement their trenches


SURVEYED IN 1908
GULF OF MEXICO
MISSISSIPPI RIVER
The break in Cubits Gap occurred subsequent to 1860, the date of the first survey.
SURVEYED IN 1916
Area of Delta from survey of 1872.
Recession of shoreline and area of erosion.
Extension of shoreline and area of deposit.
0 1 2 3 4 5 6 7
Statute Miles

SKETCH MAP OF THE MISSISSIPPI DELTA SHOWING FORMATIONS

hanna, the Potomac, and the James rivers rolled in stately grandeur to the sea. Then there came a subsidence, and the sea rushed in through the reach between Capes Charles and Henry and overwhelmed the land in all that vast area we call Chesapeake Bay.

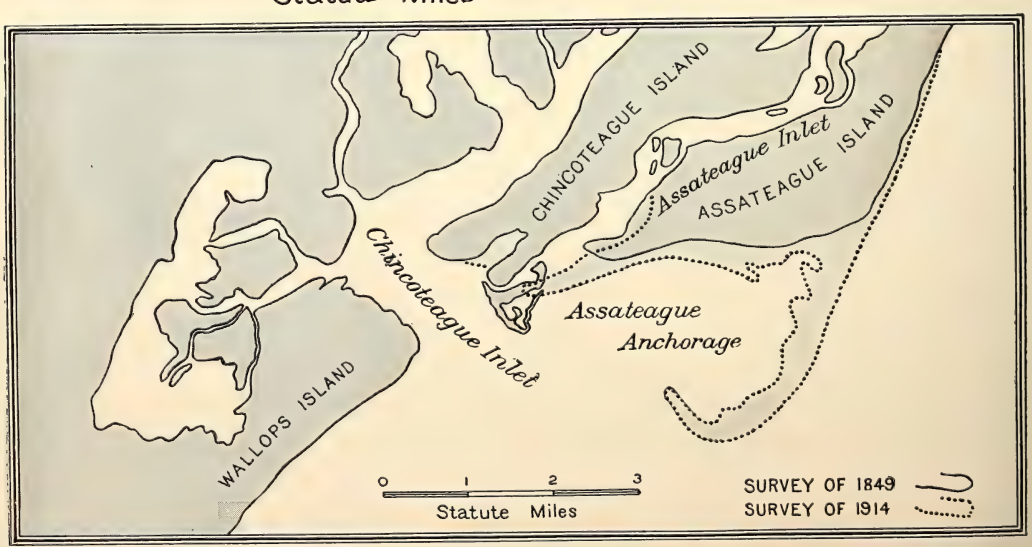
The land has not always been without an ally to counterbalance this display of strength. Sometimes there come upheavals of the floor of the sea that drive the water into a retreat which often becomes a rout.

The consequences of even a slight upheaval may be strikingly shown by following what is known as the twenty-fathom line off the eastern seaboard. This line divides the sea into two parts, that which is less than 120 feet in depth, and that which is deeper. Were the floor of the continental shelf, the vast, undersea platform upon which the continent rests, to rise 120 feet, Delaware Bay, Chesapeake Bay, Albemarle Sound, and all the other deep indentations of our coast would disappear and the new battle line would be practically without salients.

WHEN THE LAND SCORES A VICTORY

When the land is victor, through an upheaval, it always straightens out its battle front. The bed of the sea, being untouched by the chemical changes of the atmosphere, unharassed by running water, but constantly graded by deposits of sand in its low places and scoured by the tides in its high ones, is ever tending to assume a common level.

WHERE THE LAND HAS SCORED SIGNAL VICTORIES OVER THE SEA; THE UPPER CHART SHOWS LYNN HARBOR (SEE PAGE 521); LOWER CHART IS A SKETCH OF ASSATEAGUE ISLAND, VIRGINIA, SHOWING LAND DEFENSES BUILDED SINCE 1849 (SEE PAGE 528).



On the other hand, the land, attacked by chemical change, eroded by wind and running water, is an unending succession of elevations and depressions, and whenever there is a subsidence the sea seeks out every foot of ground below its level and occupies it.

Only the highest waves ever lash the sea bottom beyond a depth of 26 feet, and at 600 feet even the ripple-marks of a gentle surge disappear.

THE WINDS A BOLSHEVIK ARMY

From the Virginia capes southward, one may see the same forces at death grips that are found on the Jersey and other coasts. But neither at Cape Cod nor in Jersey will one behold to such advantage the rôle played by the wind, the Bolshevik of the land and sea war, as in the region of the kingly capes and in the vicinity of Hatteras. Now it boldly marshals its forces alongside those of the water and urges on the attack with the utmost abandon. And now, repentant of that rôle, it steps in and helps the land erect great barriers of sand, against which the wildest sea, in its maddest moments charges in vain.

The winds are the makers of dunes, the tanks in nature's war-

SKETCH MAP OF SANDY HOOK

A little south of Sandy Hook, at Long Branch, the highlands yield a continuous supply of sand to the action of the waves. This is washed up and down the beach with each advancing and retiring wave, but with each movement it is brought down to a place northerly of where it started, as the waves strike the shore obliquely and from a southerly direction. So the sand is carried along until it is deposited in deeper water, where the wave action is not so vigorous, gradually building up the bottom in much the same manner as a delta is built up at the mouth of a river. Sandy Hook is the result of this action aided by the winds which blow the wave-brought sands into dunes.

© H. C. Mann

THE SEA ATTEMPTING TO ESTABLISH A COMMUNICATION TRENCH ON THE FRONT LINE OF BATTLE IN THE VICINITY OF CAPE HENRY, VIRGINIA

Photograph by H. C. Mann

WHERE THE LAND ARMY HAS FORCED PEACE: A PROTECTED HARBOR IN SOUTHERN WATERS

fare, and the humble beginnings of these mountains of glistening sand form a remarkable story. One who has stood on a sandy beach during a lashing hurricane and has felt the shining grains hurled into his face with a sting like that of a nettle, knows the wind's power and can the more easily believe the statement of scientists that a cubic mile of churned air may contain thousands of tons of sand.

Anything of substance, from a piece of wreckage to a tuft of grass, may be the nucleus of a dune that will grow and grow, broadening out as it rises higher, burying a forest, engulfing a house, or wiping out an orchard.

The trees which the sands seek to overwhelm put up a stubborn fight for life, but usually the dune is victor, and many are the places where one may walk through a graveyard in which a forest lies buried and only a limbless upper trunk has been left as a ghost of a brighter day.

Sometimes dunes migrate and the forest that was buried yesterday awakes to life tomorrow, for the wind picks up the sand it formerly laid down and drives it still further. Cemeteries have been first sheltered by a dune, then buried by it, then resurrected from it. On the Carolina coast a human graveyard has been despoiled by the shifting sands, and as the dune moved onward in its migration the very graves were opened by the force of the wind, and the bones of those who peopled them were left scattered on the soil.

WARFARE ALONG THE FLORIDA KEYS

The Carolina coast affords a striking example of the effectiveness of the wind as an ally of the land. Borne southward by the sweeping shore-following currents that come down from the north, sands that are the remains of boulders pounded loose from some rocky coast, have driven a wedge through the left flank of the ocean and have completely isolated the attacking armies holding the salients of the Albemarle and Pamlico sounds.

The winds have aided in the campaign and have piled up veritable mountains of sand against future attacks by the sea. Thus the main battle line is straightened out and the enemy finds itself in a cross-fire, with opposing forces athwart its line of communications.

Along the southeasternmost coast of Florida, from Cape Florida, which guards lovely Miami, on down to Key West, is the beautiful key region, where the coral polyps have established foundations upon which the land has been able to build first-line defenses that break up the assaults of the sea before they reach vital ground.

Sometimes the water erects wonderful natural bridges in these barriers. On the western shore of the northern part of Biscayne Bay, which laves the shore of Alton Beach on one side and Miami on the other, a little river escapes from the Everglades to the elevated Barrier Reef through a beautiful rock arch cut by the water.

MAN AS A PROFITEER IN NATURE'S WAR

Thus having, with some little romantic license, outlined for the nontechnical reader the front-line trenches of nature's great war on our eastern coast, let us turn aside and see how man, the innocent bystander, the neutral, fares through it all.

In the attack of the sea via the air he is preëminently a profiteer. Without the water and atmosphere to weather the rocks of the mountains he would have no soil upon which to live, and without the rain that gladdens valley and plain the soil would be worthless.

But when it comes to the frontal attack he has to resort to many measures to maintain his neutrality and to prevent both belligerents from encroaching upon his domain. With his Lighthouse Service he warns the mariner of dangers ahead and directs the fleets of main and inland waters into safe channels. With his Coast and Geodetic Survey he plots the pitfalls and the safe shipways, so that the sailor may set his course without fear. With his Coast Guard he stands unending watch to help those who, in spite of all care, become entangled in the barbwire of nature's battle-fields and would perish but for its timely aid.

BEACONS THAT GUARD THE NEUTRAL'S RIGHTS

The most easterly light on the shores of the United States is that of West

Quaddy Head. From there to the southern tip of the Florida coast there are scores of beacons of the sea, some with histories that warm the hearts of those thrilled by deeds of heroism.

The one at Mt. Desert is on a bold promontory where the pounding waves break high, and have been known to lash so fiercely that they moved a rock, estimated to weigh 75 tons, a distance of 60 feet during the fury of a single storm.

The Matinicus Light has a thrilling story to tell. Once the sea made a complete breach in the rock. Only the women-folk of the keeper's family were there when the storm broke, but little Abbie Burgess, fourteen, and her sisters stood up bravely against Neptune's outburst, and for four weeks kept the light aglow, although during that entire time there was not a moment when the government keeper, their father, could effect a landing from the near-by mainland.

The Minot Ledge light, standing far out on a lone rock, where the sea rounds Cohasset and speeds into Massachusetts Bay, has a striking history. For three years men worked like Trojans to build a lighthouse upon a barren rock. Its beacon flared forth for the first time January 1, 1850. A little more than a year later, in April, 1851, a great gale swept those seas. On the night of the 16th the light was last seen from Cohasset at 10 o'clock, and the bell was last heard an hour after midnight. When morning dawned it was gone.

But that tragedy only temporarily dimmed the light of Minot Ledge. A few years later the government completed the present massive stone structure, ranking among the greatest of the sea-rock lighthouses of the world because of the engineering difficulties surrounding its erection. A considerable part of the foundation was below low water, and landings could be made only at low spring tides in a smooth sea. Work was prosecuted for three years before one stone could be laid upon another. No man who could not swim was employed, and no landing from a boat was attempted except when convoyed by another boat. A surf boat manned with three lifeguards was kept constantly on duty while the workmen were on the ledge.

THE NANTUCKET LIGHTSHIP

It would be interesting to recount the stories of Cape Cod light, and of the lightships that mark the passage through the shoals off Cape Cod and through the sounds to Buzzards Bay. But whoever thinks of lightships, thinks first of Nantucket. Mr. George R. Putnam, chief of the Lighthouse Service, in his excellent book, "Lighthouses and Lightships of the United States," tells this story of the Nantucket lightship:

"On a voyage from Europe the weather had been such that the steamer had crossed the Atlantic without the officers having secured a single observation after leaving the Irish coast. A passenger came on deck on a misty evening and heard first faintly, and then louder, the blasts of a steam whistle at regular intervals of half a minute. Then through the thin fog a white light eclipsed every quarter of a minute, and there soon loomed out of the mist in the dusk a little vessel at anchor, rolling heavily in the swell, with a red hull, and *Nantucket* in large white letters on her side.

"The great liner swept by and on toward her port, for then it was that her master had definite knowledge that he was 200 miles east of New York harbor. This lightship, anchored on one of the most exposed stations in the world, has given this message to many thousands of captains and has been the first signpost of America to millions of passengers."

WITHSTANDING THE SIEGE GUNS OF THE SEA

The Nantucket lightship is anchored in 30 fathoms of water, 41 miles from the nearest land, Nantucket Island. She is 135 feet long, with full propelling power should she part her cables. She has a crew of 15, a submarine bell, and a wireless outfit.

When the sea brings up its siege guns and heavy artillery is the time of all others for the lightship to be on its station. It must wallow in the trough of the sea as best it can and ride out the storm at a standstill, lest some hapless master get caught in the drumfire of a terrific offensive.

© Charles A. Harbaugh

OVER THE TOP

Trained from childhood in sea-lore and surf-boating, there are no better boatmen in the world than a coast-guard crew. Launching or landing through a heavy surf requires superb skill, keen judgment, and much courage. The lack of any of these requisites spells almost certain disaster—a capsize if nothing worse.

Heading inward to New York, one might tell of the Fire Island Lightship and Ambrose Channel Lightship, the latter marking the beginning of the "run" to Europe and the end of the "run" to America.

Navesink light, built on the highland of the Jersey coast just below Sandy Hook, with its seven-ton bivalve revolving lens of the lightning type, has an estimated candle-power of 25,000,000, which makes it the most powerful light in America, if not, indeed, in the whole world. The curvature of the earth cuts off its direct rays at 22 miles, but its beam has been observed in the sky to a distance of more than 80 land miles.

There is many an inspiring tale of the sea connected with Barnegat light, Absecon light, the lights that proclaim the capes at the mouth of the Chesapeake, and others to the south.

Cape Hatteras light has the distinction of being the farthest distant from the main shore of all American lights, and it is also the tallest lighthouse in the country. Spiral-painted like old-fashioned stick-candy, it is visible for many miles amid the storm-tossed waters of the North Carolina coast.

Off Hatteras there is a lightship that for the high seas and dangerous storms it must ride out is a rival of Nantucket vessel. It is the Diamond Shoals lightship.

Beyond Hatteras there are numerous great lights along the Dixie shores, each with an interesting history, each with a long record of service performed in warning craft to steer clear of the fighting zone between the water and the land. They, as well as gas buoys, fog signals, and many other warnings and guides to shipping while in the battle area, invite attention.

THE COAST AND GEODETIC SURVEY, THE WAR CORRESPONDENT

But however attractive their story, they must stand aside while some account is given of the work of the Coast and Geodetic Survey, which is ever a neutral war correspondent at the battle-front, chronicling every change in the battle-line and keeping its position up to the minute, lest shipping run upon a new bar without warning. With its ably-manned surveying vessels it journeys up and down the battle-front with an eye always out for shore changes, dangerous shoals, and such. Every skipper who sails the main may thus know where the mine-planters of the briny deep have been at work, and can steer clear of such fields.

WEARERS OF THE CROSS

In spite of all the warnings of light and bell and buoy; in spite of surveys and charts and mapped battle-fronts, there are still ships that will get into the danger zone and fall victims of the heavy artillery that sweeps the seas between deep water and the dry land. Shall they be left to perish with their crews and cargo? Not if the helping hand of Uncle Sam's coast guard can rescue them.

What tales these Red Cross men of the turbulent seas could tell! What hardships they endure! What perils they brave! To them the cry of distress in a storm-tossed ocean never goes up in vain. No bombardment of Neptune is ever so fierce that they will not dare it, no hope of a timely rescue is ever too slight to spur them on. The raging battle might as well be a blissful calm, for all its power to turn aside the life-savers from their stern duty. Aye, they may sink beneath the waves themselves, but to them even such a death is a lot infinitely preferred to life with an unheeded call from out the angry sea as a memory.

No one who has ever watched the sturdy life-savers man the lifeboat on an exposed shore and, against odds that seem insuperable, pull gallantly out into the tempest, can fail to appreciate either the stoutness of heart or the grandeur of purpose of these men. Where seemingly no boat could live, they manage to breast the storm, ride the billows, and reach the stranded vessel.

With a record of 1,500 instances of the rescues of lives and ships in a single year, it would seem invidious to single out one over another. A Sandy Hook station not long ago answered five calls in one day.

A Rhode Island station some time later saved 71 persons from the Portuguese brigantine *Est Thiago*. That vessel went

Photograph by George M. Chapin

AN ANCIENT BATTLE-FIELD: THE SAND-DUNE RAMPARTS OF SOUTHERN FLORIDA

Photograph by William Reid

A MASS ASSAULT

As the seas retreat after an unsuccessful attack, they carry along in their flight many prisoners, wrested from the land army, that are never to be set free or exchanged

Photograph by George M. Chapin

AN OUTPOST OF PALMS STANDING GUARD AGAINST AN ATTACK OF THE SEA ON THE SOUTHERN FLORIDA COAST

ashore in a fog and was totally lost. A heavy surf was running when the brigantine struck, making the launching of a lifeboat to the rescue an exceedingly difficult and perilous undertaking. Moreover, the state of the sea, once a launching was effected, was such that a boat could not run alongside the vessel. Her masts were gone, some of the planks of her port side were missing, her starboard rail was under water, and debris was thrashing around everything on board as well as over the side.

Both crew and passengers were in extreme jeopardy, and in great panic were calling for help. The commander of the lifeboat watched his chance and in the brief period between seas ran in under the flying jib-boom. Following his directions, those on board crawled out on the boom and dropped into the boat.

The rescuers did not risk stopping long under the boom—only long enough at a time to get three or four persons. The time limit of safety reached, they would scud away with all speed, to avoid being swamped or capsized by a breaking sea.

WORK OF THE COAST GUARD CUTTERS

Nor can one overlook the coast guard cutter and its work. Under presidential orders, about a dozen of these vessels patrol assigned sections of the coastal waters from Eastport, Maine, to Cape Canaveral, Florida.

Provided with liberal supplies of food, water, and fuel, they put out to sea and cruise throughout the long winter months, ever vigilantly looking and listening for vessels in distress and for opportunities to be good friends in an hour of dire need.

One cutter covers the district between Great Egg Harbor, New Jersey, and Cape Hatteras.

The heavier the blows being struck by the sea the greater the need for these cutters to be on the watch. Ships aground, afire, in a collision, indeed any S. O. S. sends the cutters full steam ahead to the rescue. Now it may be a schooner, like the *Frederic A. Duggan,* in distress some 70 miles east of Nantucket Lightship, loaded with China clay, from Cardiff, half full of water, her provisions gone and her bottom so foul that only a gale could give her headway. Now it may be the *Bay State* on the rocks of Hollicom's Cove, Maine. Now the *Antilla* sends out an S. O. S. call that she is afire 120 miles east of Norfolk, and the *Onondaga* rushes to her rescue, and, finally, with other help, gets her into port, her cargo a total loss, but the ship saved. Or it may be the transport *Sumner,* which lost her bearings in a fog December 11, 1916, and went upon the rocks of Barnegat Shoals.

RED CROSS STATIONS

In viewing the Atlantic seaboard, one finds that the opposing forces in nature's unrelenting campaign have at least paused long enough to coöperate in the foundation of Red Cross stations in neutral territory. From Maine to Florida they have established, by mutual agreement, waters in which peace prevails—harbors where fleets may find haven while awaiting call.

Few stretches of coast line in the world have more of these stations. Maine with its Eastport, Belfast, Rockland, and Portland harbors; New Hampshire with its Portsmouth harbor; Massachusetts with the harbors of Newburyport, Gloucester, Salem, Lynn, Boston, New Bedford, and Fall River; Rhode Island with Newport, Providence, and Bristol harbors; and Connecticut with those of New London, New Haven, and Bridgeport, give New England many such bases of first importance.

Between the western nose of Long Island and the eastern projection of Staten Island, New York is given a harbor with an outlet that justifies its name of "The Narrows." Beyond lies the Upper Bay and above that the deep waters of the Lower Hudson and East River, giving the city more potential water front than any other municipality in the world. New Jersey has little to offer in harbors of first importance, except the one it shares with New York and those on Raritan Bay; but it joins with Delaware in forming Delaware Bay, with its ocean outlet for Philadelphia.

Further down the coast the land sank and invited the waters in through the Virginia capes to form harbors at Baltimore, Norfolk, Portsmouth, and Newport News. At Wilmington, N. C.; Charles-

ton, S. C.; Savannah, Ga.; Jacksonville and Key West, Fla., are Red Cross stations of the first order, all directly or remotely built up by mutual consent of the warring elements, so that man, the innocent bystander, can seek safety when the front-line trenches become untenable for visitors.

THE SEA DOOMED TO DEFEAT

Such, briefly told, is the story of the great effort of the sea to bring the land under her dominion.

It is a warfare that has its lights and its shades, its tragedies and its joys. Furthermore, it is a warfare with striking analogies to the great conflict of democracy against despotism, and just as surely as the upheavals that raised the Piedmont plains above the sea drove the ocean back and set the American continent firm and strong, so will democracy rise up in its power and successfully vanquish its foe, however subtle, however persistent, however relentless that foe may be.

PRUSSIANISM *

By Robert Lansing, Secretary of State

THE American people by a gradual process of reasoning have reached the firm conviction that a German victory in the European struggle would result in the greatest of perils in this country and to those principles of government which have been ours since we became an independent nation. Whatever may have been our past judgments, we now realize the sinister character of Prussianism which has been manifested in this war.

And yet, with this realization of the truth, I find that many Americans, even among those intellectually equipped, have but vague ideas of the perverted mental attitude which made Prussianism possible, and of the reason why a compromise founded upon the Prussian conception of international rights must not even be considered.

THE RELATION OF PRUSSIANISM TO PEACE

To a man who thinks true in these days when passion or hysteria distorts opinions, Prussianism and the idea of an enduring and just peace among nations can never be brought into harmony. They can no more mingle than can oil and water. They are at the very antipodes of human thought. We should, then, comprehend the true meaning of Prussianism in order to understand the great obstacle today to a return to peace while Prussianism is still a power.

In considering the elements of Prussianism which made this war inevitable, we should also consider the relation of Prussianism to peace, the supreme desire of mankind, and its relation to war with all its suffering and destructiveness. The wastes of western Europe, the ships and corpses in the ocean's depths, the forest of crosses marking the graves of slaughtered men, the legions of torn and crippled humanity, and the wretched throngs of unhappy women and children are sad witnesses to the horrors of war. On these spectacles of brutality, misery, and desolation all civilized peoples gaze with anguish and bitterness.

As there comes an increasing realization of the needlessness of it all, indignation and anger burn in the hearts of men. But in spite of the bitterness aroused by these tragical scenes, they hope for peace, they pray for peace, and they look forward to that day when rest will come to this tormented world which has endured so much.

Yet, even as they hope and pray and search the future with yearning eyes, the armies and navies of democracy fight on with a grim determination which seems to contradict the hope and purpose of humanity.

* An address to Union College, June 10, 1918.

Peace the world may seek with passionate longing, but not a peace which contains the seeds of future wars and future suffering. When an end comes to this great war, as it will come, it must result in a peace that is final and enduring.

"AN UNSTABLE PEACE WOULD BE A CURSE"

Surely mankind has not borne this burden of agony for naught. After all this woe and waste, a temporary and unstable peace would be a curse rather than a blessing.

A firm foundation must be found and is to be found in the frank and clear declaration by President Wilson of the aims which the Republic seeks in this war and which, with God's help, it will attain, whatever the cost may be. Nothing less will satisfy the American people; nothing less will content the democracies of the world.

The conditions which prevailed prior to August, 1914, produced this conflict. It is not, then, in a return to the *status quo ante* that lasting peace is to be found, though that, with domination of the Slavic peoples on their eastern borders, appears now to be the minimum terms of the Teutonic powers. To restore those pre-war conditions would be to invite a new disaster. Peace must rest on a more substantial basis, for the world seeks to have done with war and with conditions which produce war.

However long it may take, however great the sacrifice may be, physical might uncontrolled by morality must never again be considered a standard of international right. Justice must and will become the supreme force in human affairs. No other result will insure civilization against the evil passions which today convulse the earth.

THE BLOOD OF THE BRAVE NOT SHED IN VAIN

I do not believe—in fact, it seems to me to be unbelievable—that the blood of brave and devoted hearts, so generously poured out on land and sea in the cause of liberty, is being shed in vain, or that the vast treasures, wrested from the earth by man's enterprise and industry, are being wasted in the support of so sacred a cause.

But these lives and these riches have been wasted unless from the ashes of these sacrifices, which have been offered on the altar of liberty, there arises a peace which shall endure. It cannot be that the merciful Ruler of the Universe has permitted humanity to suffer all this without conferring a lasting blessing.

The conditions which brought on this war are rooted in the past and are not of sudden or spontaneous growth. They are the natural development of influences which have been long at work in Prussianized Germany and which the rest of the world ought to have perceived, but did not.

We can now with a clear vision look back through the history of Prussia and see the motives which inspired the conduct of her rulers. We can now read the words of Prussia's statesmen and of the masters of recent German thought with understanding minds.

THE CENTRAL THOUGHT OF PRUSSIANISM

We now recognize that the policies of the Imperial Government of Germany and the boasted "kultur" of the German people have been concentrated on the single purpose of expanding the territory and power of the Prussian Emperor of Germany until he, through the possession of superior force, became the primate of all the rulers of the earth. World dominion was the supreme object. That was and is the central thought of Prussianism.

It excited the cupidity of the governing and wealthy classes of the Empire and dazzled with its anticipated glories and by its promise of a boasted racial superiority the German millions who were to be the instruments of achievement.

Germans of high and low degree believed dominion over all nations to be the destiny of their race, and with a devotion and zeal worthy of a better cause turned their energies into those channels which would aid the ruling class in their plans to attain the summit of earthly power, Germany's vaunted "place in the sun."

I know that many Germans indignantly deny that this ambition for su-

Photograph by A. E. Young

ALL THE RESOURCES OF OUR REPUBLIC ARE ENLISTED IN THE STRUGGLE TO PREVENT THE DOMINATION OF THE WORLD BY THE TEUTONIC EMPIRE

A freight steamer of the Great Lakes is doing its vital bit in transporting raw material to the munition plants, where shell and cannon are being manufactured to blast Germany's ruthless ambitions for world dominion.

premacy has inspired the conduct of the German Government or that it existed in the minds of the German people. I wish sincerely that it were so, for it would make the problems of the future far more easy of solution. But the numerous utterances of German thinkers and writers belie these defenders of Germany's purity of motive.

AN AMBITION TO BE "SUPERMEN"

It is hardly open to debate, in the light of subsequent events, that the philosophical and political ideas which have been taught for years from the university platforms, from the pulpits, and through the printed word to young and old in Germany excited in them an insolent pride of blood and infused into their national being an all-absorbing ambition to prove themselves "supermen," chosen by natural superiority and by divine mandate to be rulers of the earth.

Not only in Germany but among those of German descent in other lands has this pernicious belief spread, linking Germans everywhere to the "Fatherland" in the hope that they would be considered worthy to share in the future glory of the masters of the world.

A few examples of the teachings which have so molded German character and implanted in the German mind false conceptions of life will suffice to show their nature and the evil influences which they exerted on a people peculiarly susceptible to flattery and possessed by a selfishness which blunted their sense of honor and of moral obligation.

Professor Theuden, imbued with an astounding vanity, which is characteristically German, declared, as the great war began: "Germany, as the preponderant power in a Pan-German League, will with this war attain world supremacy." And Poehlmann, in considering the good to Germany which would result from the conflict, wrote to his fellow-countrymen, "We shall be an unconquerable people capable of ruling the world."

A SINISTER GERMAN CONFESSION

These words but described those visions which the German philosophers, acting possibly under the direction, and certainly with the approval, of their government, had so constantly conjured up to allure and tempt the German people. They were uttered before the great Prussian war machine had failed in its first endeavor to plough its way through to Paris and in proving itself to possess the irresistible force in which its builders believed.

A decade before the war Reiner, inspired with the imperialism of Prussia, announced: "It is precisely our craving for expansion which drives us into the paths of conquest, in view of which all chatter about peace and humanity can and must remain nothing but chatter."

Not less ominous to liberty are the words of Professor Meinecke: "We want to become a world people. Let us remind ourselves that the belief in our mission as a world people has arisen from our originally purely spiritual impulse to absorb the world into ourselves."

Observe that extraordinary phrase: *"To absorb the world into ourselves."* To conceive such a national destiny is to resurrect the dead ambitions of an Alexander or a Cæsar; to teach it as a right to young men is to sow in their minds an egotism which breeds distorted conceptions of individual honor and justice and gives to them an utterly false standard of national life.

THE PRUSSIAN DOCTRINE: "AS WE WILL IT!"

Not alone from the lecturer and the essayist came this idea that the Germans are a superior race, set apart to rule the world. It was preached in the pulpits as a divine truth by those who even had the effrontery to support their assertions by references to the Holy Scriptures. Listen to some of the thoughts proclaimed by ordained ministers of Christ to their German congregations:

"It may sound proud, my friends, but we are conscious that it is also in all humbleness that we say it: the German soul is God's soul; it shall and will rule over mankind."

May we be spared the consequences of German "humbleness," which fairly struts and swaggers and which finds further expression in the words of another doctor of divinity, when he declares:

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AMERICA'S APPEAL TO PATRIOTS WAS NOT IN VAIN

"The only way to stay the onrush of blood and desolation is to prove conclusively that the Prussian masters of Germany do not possess the physical might to impose their will on the human race."

"Verily the Bible is *our* book. It was given and assigned to *us*, and in it we read the original text of *our* destiny, which proclaims to mankind salvation or disaster, *as we will it.*"

"As we will it!" There, in four words, is the whole story of the Prussian doctrine of the "superman," of a "place in the sun," of "world dominion." What a combination of sacrilege and vanity to assume that the Almighty would confer on a people such as the Prussians have shown themselves to be divine powers on earth!

These are enough, though many more might be given, to show the monstrous ideas which have for a generation been poured into the receptive minds of a stolid, stubborn people, unhabituated to

think for themselves, who have, through these ideas, become fairly saturated with the belief in their invincible power, in their racial superiority, and in God's selection of them, or rather their rulers, to be His partners in governing the world.

"WE ARE THE HAMMER OF GOD"

Side by side with the egotistical conception of the Prussians that they have a monopoly on the favor and power of the Creator, there is another which is utterly savage and unchristian. While it has been variously expressed by the materialists of this generation, Felix Dahn forty years ago uttered the naked thought, which has since been interpreted into action by German militarism.

Thus wrote the poet: "It is the joyous German right with the hammer to win land. We are of the Hammer God and mean to inherit his empire." That is, the earth.

This deification of brute force, with the attendant right of the strong to be masters of the weak, touched a responsive chord in the Prussian mind, and was by some paradoxical process welded to the so-called Christian philosophy of Prussia's theologians.

Thus Thor and Odin stalk again along the shores of the Baltic summoning the tribesmen to battle. Their blood-stained altars have again burst into flame in the hearts of the Prussians. Their fierce priesthood again clamor for victims. In the place of a god of love and mercy the Teutons of the north have raised on high their ancestral gods of brutality and war.

Paganism, tinctured with modern materialism and a degenerate type of Christianity, broods today over Germany. Christian ministers have proclaimed Jehovah to be the national deity of the Empire, a monopolized "German God," who relies on the physical might of His people to destroy those who oppose His will as that will is interpreted by His chosen race. Thus the Prussian leaders would harmonize modern thought with their ancient religion of physical strength, through brutalizing Christianity.

Minds filled with such conceptions of the sacredness of conquest and of the divine right of a ruler to command obedience have furnished fertile soil for the Prussian policy of acquiring territory and mastery by brute force, regardless of justice, morality, or the rights of others.

This strange mental slavery of a people as highly developed intellectually as the Germans is one of the most extraordinary psychological phenomena of modern times. It is hard to analyze it, and even harder to find for it a plausible explanation.

In such congenial environments the ideas of the absorption of Belgium and the Netherlands, of the Germanizing of the Scandinavian and Slavic countries, of Mittel-Europa, and finally of a world empire greater even in relative extent than that of Macedon or Rome, germinated and thrived.

VAST INTRIGUE SET AFOOT

To make ready for the year and the day when these extravagant dreams of conquest were by force of arms to be made realities and when all nations would be subjugated by the imperial power of Germany, absorbed the thought and dictated the acts of the Prussians who had so successfully subdued their Germanic neighbors, at first physically and later mentally, until they belonged body and soul to their war lords.

With this vast ambition in their hearts, the rulers of Germany sent forth swarms of agents throughout the world to create, in so far as they were able, conditions favorable to the great enterprise. Some sought to win the good will of the nations to which they were sent; others to alienate or weaken the friendships between nations whose alliance or mutual support the German Government feared would constitute a possible obstacle to its great scheme of world conquest.

Sincere and honest, the governments against which these intrigues were directed believed the Imperial German Government to possess a character like their own. Naturally trustful, they fell victims to the snares set to entrap them. There seems to have been no depths of infamy which the Germans did not sound in carrying out their foreign policy of deception.

In what a new light many events of the past appear when the truth becomes

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HE GOES FORTH TO FIGHT FOR THE SAFETY AND HAPPINESS OF FUTURE GENERATIONS

"As the world hopes and prays and searches the future with yearning eyes, the armies and navies of democracy fight on with grim determination."

known! The "Yellow Peril" speech of the Kaiser, the wholly unjustified suspicions of imperialistic designs on the part of the United States whispered artfully among nations of South America, the financial schemes and revolutions promoted secretly by Germans in the Caribbean countries, the encouragement of continued turmoil and anti-American feeling among warring factions in Mexico, and the propaganda of distrust and hostility carried on in this country and in Japan are among the things "made in Germany" directly affecting the international relations of the United States.

It is only within a comparatively recent time that we were fully convinced of their origin and gave them their true labels. Yet, because we were so innocent and trusting, the unpleasant truth comes as a greater shock and excites a deeper resentment.

In addition to these practices, which had been in operation long before the great war and were preliminary to that supreme event in the Prussian plan, I might refer to the plots which, after the war began and while this country was still neutral, were directed, approved, or financed by Count Bernstorff, Von Papen, Boy-Ed, Luxburg, Von Eckhardt, and other official representatives and secret agents of the Berlin Government. But the activities of these men have been exposed and their disgraceful record is common knowledge, arousing a just indignation throughout this country.

WATCH LONG KEPT ON GERMAN CONSPIRATORS

I think that I might say, however, that for a long time before it was considered wise to make the facts public the American Government, possessing evidence of their improper conduct, kept constant watch over these conspirators, who depended upon the innocent credulity of "those idiotic Yankees," as Captain Von Papen sneeringly called us.

These complacent plotters little suspected how much was known of the activities of the German embassy in Washington, the military agency in New York, the consulates in various cities, and the numerous spies in German employ by those whom they thought they were deluding. These agents credited the miscarriage of many of their schemes to chance, which had they known the true cause would have given them some very indigestible food for thought.

In view of this spirit of hypocrisy and bad faith, manifesting an entire lack of conscience, we ought not to be astonished that the Berlin foreign office never permitted a promise or a treaty engagement to stand in the way of a course of action which the German Government deemed expedient. I need not cite as proof of this fact the flagrant violations of the treaty neutralizing Belgium and the recent treaty of Brest-Litovsk. This discreditable characteristic of the German foreign policy was accepted by German diplomats as a matter of course and as a natural, if not a praiseworthy, method of dealing with other governments.

AN AMAZING INSTANCE OF BAD FAITH

Frederick the Great, with cynical frankness, once said: "If there is anything to be gained by it, we will be honest. If deception is necessary, let us be cheats." That is, in brief, the immoral principle which has controlled the foreign relations of Prussia for over a hundred and fifty years.

It is a fact not generally known that within six weeks after the Imperial Government had, in the case of the "Sussex," given to this government its solemn promise that it would cease ruthless slaughter on the high seas, Count Bernstorff, appreciating the worthlessness of the promise, asked the Berlin foreign office to advise him in ample time before the campaign of submarine murder was renewed in order that he might notify the German merchant ships in American ports to destroy their machinery, because he anticipated that the renewal of that method of warfare would in all probability bring the United States into the war.

How well the ambassador knew the character of his government, and how perfectly frank he was. He asked for the information without apology or indirection. The very bluntness of his message shows that he was sure that his superiors would not take offense at the assumption that their word was valueless

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"THE WORLD MUST HAVE A PEACE THAT WILL MAKE NEEDLESS THE MARSHALING OF ARMIES"

and had only been given to gain time, and that, when an increase of Germany's submarine fleet warranted, the promise would be broken without hesitation or compunction. What a commentary on Bernstorff's estimate of the sense of honor and good faith of his own government!

DECEIVED BY MILITARY CLIQUE OF BERLIN

Before this war began we would not have thought any government on earth capable of such indifference to truth. We admit that we have been the dupes of the military clique in Berlin, because dishonesty of this sort seemed to us inconceivable in these days of international honor and Christian civilization. But I believe that the nations, and I am certain that the United States, will never again be caught in a net of duplicity equal to that which was spread all over the world by the Berlin Government. We have learned our lesson and it has cost us dear. We will never have to learn it again.

In this consideration of Prussianism, with its pagan philosophy and its perversion of the German mind, I shall not attempt to enter upon a recital of the horrible brutalities perpetrated by the German armies in the prosecution of the war. They have been too often told to require repetition. It would be the needless reading of a catalogue of black deeds of cruelty, which would sicken a tiger, by a nation which claims not only to be moral and possessed of humane sentiments, but to be actually commissioned by the Supreme Being to carry out His will.

I only mention them here as a further manifestation of the revival in Germany of the adoration of brute strength and pitiless war and of the subordination of every noble instinct to the heartless materialism of the ruling class, who seek only power and possessions without regard to the means by which they are

attained. In a word, to show what Prussianism means when translated into action.

GOETHE'S ESTIMATE OF THE PRUSSIANS

But we ought not to be surprised at these terrible manifestations of frightfulness, in view of the past record of Prussia. It was Goethe, I think, who said, "The Prussians are naturally cruel; civilization will make them ferocious." It has made them ferocious. Acquired science merely gave them increased ingenuity in the indulgence of their passion for cruelty.

Let me read you an extract from an article which appeared in the *Fortnightly Review* of February, 1871; and, as I read, remember this was written of the German invasion of France nearly half a century ago. It might have been written in February, 1915, so truly does it portray Prussianism as we know it today:

"For six months one-third of France has been given up to fire and sword. For 300 or 400 miles vast armies have poured on. Every village they have passed through has been the victim of what is only an organized pillage. Every city has been practically sacked, ransacked on system; its citizens plundered, its civil officials terrorized, imprisoned, outraged, or killed.

"The civil population has been, contrary to the usage of modern warfare, forced to serve the invading armies, brutally put to death, reduced to wholesale starvation and desolation. Vast tracts of the richest and most industrious districts of Europe have been deliberately stripped and plunged into famine, solely in order that the invaders might make war cheaply.

"Irregular troops, contrary to all the practices of war, have been systematically murdered, and civil populations indiscriminately massacred, solely to spread terror. A regular system of ingenious terrorism has been directed against civilians, as horrible as anything in the history of civil or religious wars.

"Large and populous cities have been, not once, but twenty, thirty, forty times, bombarded and burnt, and the women and children in them wantonly slaughtered, with the sole object of inflicting suffering. All this has been done, not in license or passion, but by the calculating ferocity of scientific soldiers."

And yet the world, in spite of this hideous picture of Prussianism, failed to read the truth or to profit by it. Today the beast is again at large, devouring the helpless victims who fall into his power. Has not the time come to end this fiendishness?

Much as enlightened mankind may revolt at the idea, the only way to stay this onrush of blood and desolation, which is the direct consequence of the mad impulses which now hold sway over the German mind, is to prove conclusively that the Prussian masters of Germany, though they are armed with the full strength of the Empire and of its subservient allies, do not possess the physical might to impose their will on the human race, that the ancient gods of the Teutons are false gods, and that the philosophy which has cast over the German people a robe of superior attributes is the product of a consuming vanity and pride.

This idea is distasteful, as it should be, to a world which loves peace and craves repose, because the only instrument which can be employed is force of arms. It means war, unceasing war, until the arrogant and brutal Prussians are humbled, until the Kaiser and his military chieftains despair of their ambitions, until the German people realize that their insolent lords are not touched by divine fire and do not have at their command the powers of heaven.

THE WORLD NEVER AGAIN TO BE VICTIMIZED BY PRUSSIAN PERFIDY

The great free nations of the globe have the task laid upon them to destroy the spirit of Prussianism. This they must accomplish if they would preserve for the future those rights of man which it has taken centuries of struggle to wrest from the grasp of despotism.

If the German Government as it is now constituted should succeed to any extent in its purposes, or even if it should not be defeated in the present war, the doctrine and hopes which are now dominant over the German people will not die. Peace under such conditions could hardly

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SOLDIERS OF OUR NATIONAL ARMY TRAINING TO THWART THE DREAM OF PAN-GERMANISM

"Peace the world may seek with passionate longing, but not a peace which contains the seeds of future wars and future suffering. When an end comes to this great war, it must result in a peace that is final and enduring."

mean more than a brief respite from bloodshed, an unstable truce, during which the Prussian rulers of the Central Powers would devote their energies to preparing for another onslaught on democracy and liberty, for another attempt to win world sovereignty.

It is true that the free peoples of the earth would never again be found as unprepared as they were before this war to meet a militant Germany and would never again be victimized by German intrigue and perfidy. Every government would look to that. But such a state of uncertain peace would compel the whole world to remain under arms in anticipation of German aggression. The resources of the nations, already so heavily taxed by this war, would have to be further burdened for the maintenance of great military and naval establishments. Peace would be in constant jeopardy because it would depend on the belief of Germany's rulers as to their ability to succeed in a new essay of conquest.

It is not such a peace as that which will satisfy the longing of the world. It seeks and must have a peace which will silence for the future the clash of arms and will make needless the marshaling of armies and the assembling of navies—a peace so secure and so certain that man's energies may be safely devoted to the productive and not the destructive pursuits of life, and nations may develop without fear of becoming the prey of foreign aggression.

This great war must end with a decision which will be a blessing and not a curse to the present generation and to future generations. Prussianism, with its distorted ideas, its false conceptions, and its intolerable cruelties, must be brought to an end. The Germanizing of other countries must cease. The dream of "Hamburg to the Persian Gulf" and of an enslaved Poland and Russia must be dispelled.

German diplomacy and intrigue, as now practiced, must be proclaimed an international crime and suppressed forever.

The philosophy of the "superman" and of world mastery must die discredited. The evil influences which have so long poisoned the minds of the German people must lose their potency.

Until these great objects are accomplished, as they will be when the war aims stated by the President are attained, we must go on with the war. There is no other way. Peace without a radical change in present conditions, or even in those conditions preceding the war, would be interpreted by the German people as a vindication of Prussianism. The German Empire would continue to accept its doctrines and to menace the world.

We must go on with the war, intensifying our efforts and expending all our energies and resources, if need be, to obtain the great purpose for which we strive. This task must not be left half done. We must not transmit to posterity a legacy of blood and misery. The world must be made a safe place in which nations and individuals may live free and happy lives.

We must go on with the war until the desire of the nations is satisfied and until human liberty is forever freed from the peril which will continue so long as greed and ambition and blood lust dominate the German Empire, so long as Prussianism is supreme in the mind of the German people.

A MIGHTY CRUSADE

We may in this great conflict between civilization and savagery go down into the valley of shadows because our foe is powerful and inured to war. We must be prepared to meet disappointments and temporary reverses, but we must, with American spirit, rise above them. With courageous hearts we must go forward until this war is won.

Closely associated, as I have been in these critical days, with our great leader, Woodrow Wilson, I have been more and more impressed with his wise judgment, with his stern determination to lead democracy to victory, and with his utter confidence in the unity and splendid spirit of the nation.

Let us, as loyal citizens of the Republic, serve in this mighty crusade against Prussianism, confident, as our President is confident, that the righteousness of our cause and the courage and tenacity of the American people will carry this war through to victory and to peace.

THE BLACK SHADOW WHICH THE DREAM OF PAN-GERMANISM CASTS OVER THE WORLD

According to the openly professed aspirations of German statesmen and would-be empire builders, the Germany-Over-All of their dreams embraces an area of 29,000,000 square miles—more than one-half of the land area of the world. This territory which they covet is inhabited by three-fourths of all the people on earth. But even these wild dreams do not tell the whole story of the Prussians' lust for empire and power; they also aspire to the domination of the United States and what remains unconquered of all Russia, adding 11,000,000 square miles of territory and 215,000,000 people (see the shaded portion of the map). All these lands and peoples are sought by means of the sword that was drawn in dishonor and will be sheathed in shame.

GERMANY'S DREAM OF WORLD DOMINATION

By the Editor

PALTRY indeed seem the dominions of all the tyrants of the past, who attempted to "wade through slaughter" to the throne of world empire, compared with the vaulting ambition of the Hohenzollerns for Prussianizing the earth, as seriously proposed by statesmen, diplomats, and military experts of Germany during the last few years.

Our talented Secretary of State, Mr. Robert Lansing, in the preceding article has revealed the mental attitude of autocratic Prussia toward the remainder of the world. Supplementary to that revelation, it is worth while to recall some of the concrete utterances of Pan-Germans concerning their specific aspirations.

Ridiculous and grotesque would be the claims of these apostles of Germany-Over-All were it not for the fact that such extravagant preachments to the German people have brought about a debauch of blood, rapine, and destruction the like of which has never before afflicted mankind.

The accompanying map of the world tells the story of Germany's all-grasping aims. The areas in black are her own and those lands of her neighbors which she covets.

At the time that Germany plunged the world into war four years ago, the area of her empire in Europe was 208,780 square miles—larger than that of any other nation in continental Europe save her vassal, Austria-Hungary, and Russia. She had a population at home of nearly 70,000,000, while her colonial empire, exceeding a million square miles, had an additional population of more than 14,000,000.

But she was not content. These possessions must be but the core of the great sphere of dominions which she would accumulate in a rolling tide of blood conquest!

GERMANY'S DREAM

Germany claims as her right (through her spokesmen, the leading citizens of the empire), the following:

All of Europe save Portugal, Spain, the uninvaded portion of France, the British Isles, and the as yet unconquered portions of Russia. In brief, she wants in Europe 1,196,000 square miles of the total continental area of 3,872,000 square miles and 270,000,000 of the 464,000,000 inhabitants.

All of South America save the two inconsequential colonies of British and French Guiana. Her aspirations in this sphere include more than 7,400,000 square miles of the total continental area of 7,570,000 square miles and 55,421,200 of the total population of 55,779,000.

In Africa her modest claims embrace 6,840,000 square miles of the total area of 11,622,000 square miles, leaving less than 5,000,000 square miles, largely desert, for her sister nations. The territory which Germany claims in this part of the world maintains a population of 85,000,000 inhabitants, compared with only 57,000,000 for the remainder of the continent.

Considering the extent of the continent, Germany's Asian aspirations would seem amazingly conservative *for her*, were it not that much of the land to which she waives claim is, like that in Africa, an unproductive waste. With Russian Turkestan, India, China, vassal Turkey, and the Mohammedan realms of Persia and Afghanistan—the areas which she wants—the Central Empire would have 5,662,000 square miles of this continent, sustaining a population of approximately 775,000,000. And there should be added to these figures the Dutch East Indies, Germany's by right of the might of larger nations over smaller neighbors—735,000 square miles and 48,000,000 people.

All of Australia, with an area of 2,974,581 square miles and a population of nearly 5,000,000. Teuton expectations in this continent have been revealed very recently in the unblushing confessions of Herr Thysson, who is quoted elsewhere in this article.

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SOLDIERS OF AMERICA: DISCIPLES OF WORLD PEACE, OF HUMANITY AND JUSTICE

"It is unbelievable that the blood of brave and devoted hearts, so generously poured out on land and sea in the cause of liberty, is being shed in vain."

ASPIRATIONS IN NORTH AMERICA

Of North America the Pan-Germans profess to covet only Cuba, Central America, and Canada at the present time, but some of her futurists see "the American people conquered by the victorious German spirit, so that in a hundred years the United States will present an enormous German Empire." However, Cuba, the Central American republics, and the British Dominion would add 13,500,000 to the population of Germany-Over-All and an area equal to more than 18 times her European empire at the outbreak of the world war.

Thus it will be seen that the lands and peoples which German statesmen and would-be empire builders actually claim as their right equal 29,000,000 square miles, or more than one-half of the earth's surface, and 1,245,000,000 inhabitants—three-fourths of all the people on the globe.

If we should add to these figures the United States, concerning which certain bold Teutonic spirits have already expressed themselves, and the Russian Empire, which Germany undoubtedly will subjugate unless America and the Entente Allies crush her, the grand total of Kulturland would be 40,000,000 square miles, more than 70 per cent of the earth's land area, and 1,459,000,000 people, all the human beings who breathe save 237,000,000.

What a Gargantuan structure compared with the pigmy Roman Empire in its most extensive hour, under Trajan, when its subjects numbered a hundred million and the word of its Emperor was law over 1,971,000 square miles! And how Alexander would have wept with chagrin at the puny confines of his 2,170,000 square miles of territory in the light of this Brobdingnagian German dream of conquest!

THE KAISER'S WORSHIP OF RUTHLESS CONQUERORS

And by far the most diabolical aspect of this craving for world power is the fact that it has never occurred to the Prussian mind to acquire influence through helpfulness to others. Always it is the sword of the conqueror which beckons the Kaiser. This assertion is not inferential; it is based on the avowed statement of the German war lord himself, who boasts thus:

"From childhood I have been influenced by five men—Alexander the Great, Julius Cæsar, Theodoric II, Frederick the Great, and Napoleon. Each of these men dreamed a dream of world empire. I have dreamed a dream of German world empire and my mailed fist shall succeed."—From Ambassador Gerard's "Face to Face with Kaiserism," page 16.

Each of those paragons of power, which Wilhelm II keeps enshrined in his heart, had as his sole object in life the glorification of self at the expense of mankind, and the attitude of each toward justice and moral law was the same as that of German leaders today, as so shamelessly admitted by Prince von Buelow in an address before the Reichstag on December 13, 1900, when he declared, "I feel no embarrassment in saying here, publicly, that for Germany *right* can never be a determining consideration."

Here are the words of her statesmen, captains of industry, and publicists, which prove the iniquity of Germany's all-embracing covetousness:

HERR THYSSON'S AMAZING CONFESSION

"I was personally promised a free grant of 30,000 acres in Australia and a loan from the Deutsche Bank of £150,000, at 3 per cent, to enable me to develop my business in Australia. Several other firms were promised special trading facilities in India, which was to be conquered by Germany, be it noted, by the end of 1915. A syndicate was formed for the exploitation of Canada. This syndicate consisted of the heads of 12 great firms; the working capital was fixed at £20,000,000, half of which was to be found by the German Government.

"Not only were these promises made by the chancellor; they were confirmed by the Emperor, who on three occasions addressed large private gatherings of business men in Berlin, Munich, and Cassel in 1912 and 1913. I was at one of these gatherings. The Emperor's speech was one of the most flowery orations I have listened to, and so profuse

were the promises he made that, were even half of what he promised to be fulfilled, most of the commercial men in Germany would become rich beyond the dreams of avarice.

"The Emperor was particularly enthusiastic over the coming German conquest of India. 'India,' he said, 'is occupied by the British. It is in a way governed by the British, but it is by no means completely governed by them. We shall not merely occupy India; we shall conquer it, and the vast revenues that the British allow to be taken by Indian princes will, after our conquest, flow in a golden stream into the Fatherland. In all the richest lands of the earth the German flag will fly over every other flag.'"—HERR AUGUST THYSSON, Germany's greatest steel manufacturer, in a pamphlet wherein he confesses his complicity in an Imperial plot formulated in 1912 to plunge the world into war for Germany's profit.

TANNENBERG'S FORECAST

"Holland, together with her royal family, her European possessions, and her colonies in South America, the Indian Islands, and Australasia, must become the ally of Germany.

"It would form the nucleus of a colonial world empire, if to East Africa, the Cameroons, and southeast Africa we could add Angola and the Congo. As a connecting link with the Cameroons, the French Congo might also be included—7,500,000 square miles, in addition to our 2,265,560. This might justly be called a world empire rich in the productions of tropical flora; the Congo, one of the largest rivers in the world—a colonial possession comparable to England's five—a beginning, by means of which the German nation may finally attain the position to which it is entitled by reason of its importance in the Council of Nations.

"Germany must also have a share in this worship of greatness, and will, under the guise of economic exploitation and protection, win back to 'Kultur' the Asiatic possessions of Turkey, both for her own benefit and the good of the natives.

"To Germany falls, in southeast Asia, yet another possession, namely, the islands of the Indian Ocean, which, next to British India, form the most valuable colony in the world.

"In order to maintain the balance of power, Germany will be compelled to bring under her sway the largest possible stretch of land in the basins of the two Chinese rivers—the Hwangho and the Yangtsze-kiang.

"In Central America we Germans have let slip the opportunity for obtaining Cuba.

"I have touched upon these incidents in South Africa merely to enforce the point for our future guidance in South America, that it will but be a blessing for the peoples of the republics when they pass from the effects of their Portuguese-Spanish heritage under German rule.

"Germany must lay hands upon Central Africa, from the mouth of the Orange River to Lake Chad, from the Cameroons Mountains to the mouth of the Rovuma; she must seize Asia Minor and the Malay Islands, in southeast Asia, and, lastly, the southern half of South America. . . .

"These regions (Asia Minor, Syria, and Mesopotamia) might become for us what Egypt is for England—that is to say, not only an important outlet for the products of our national industry, but also a starting point from which we may extend toward eastern Asia and Africa."—TANNENBERG, in *Gross Deutschland*.

"PLANT OUR FOOT WHERE IT APPEARS IMPORTANT"

"Should it be necessary to increase our territory in order that the greater body of the people should have room to develop, then in that case we will take as much land as would appear to be necessary. We will also plant our foot where it appears important to us on strategic grounds to do so in order to maintain our impregnable strength. Thus if it is of any use to our position of strength in the world, we will establish stations for our fleet—for example, Dover, Malta, and Suez."—WERNER SOMBART.

"We must create a Central Europe, which will guarantee the peace of the entire continent from the moment when it

shall have driven the Russians from the Black Sea and the Slavs from the south and shall have conquered large tracts to the east of our frontiers for German colonization."—PAUL DE LAGARDE, in *Deutsche Schriften.*

"Denmark, as commanding the approaches to the Baltic, is of great military importance to us."—General VON BERNHARDI, in *Germany and the Next War.*

"Our Central Europe enlarges and secures the northern countries by sea-power and secures and enlarges the southern countries by land power; and unites both parts, Orient and Occident, in one vital, manifold, single organism, thanks to imperative geographical law."—ERNST JACKH, in *Deutsche Politik* (June 16, 1916).

". . . the supreme importance to us of keeping open, at all costs, the passage through the Sound and the Great Belt. The command of these straits will not only secure the Baltic basin for us, but also keep open the sally ports for our offensive operations against the English blockading fleet."—General VON BERNHARDI, in *Germany and the Next War.*

"Pan-Germanism absorbs also the Scandinavians."—ERNST HASSE, in *Zwanzig Jahre Alldeutscher Arbert.*

"We require those new Dutch territories, already fertilized by German blood, for the indispensable expansion of our economic dominion. On the Rhine, which has become German to the mouth, we need a free traffic, which the silent resistance of Holland now hampers."—FRITZ BLEY, quoted by Andler, *Pan-Germanism.*

"ALL FOREIGN INFLUENCE IN MIDDLE EUROPE MUST BE ELIMINATED"

"The future territory of German expansion, situated between the territories of the Eastern and Western Powers, must absorb all the intermediate regions; it must stretch from the North Sea to the Baltic; from the Netherlands, taking in Luxembourg and Switzerland, down to the islands of the Danube and the Balkan Peninsula, and would include Asia Minor as far as the Persian Gulf. All foreign influence must be eliminated."—ERNST HASSE, in *Weltpolitik.*

"We will annex Denmark, Holland, Belgium, Switzerland, Livonia, Trieste, Venice, and the north of France from the Sombre to the Loire. This program which we propose is not the work of a madman, nor is this empire which we wish to found a Utopia. We have already in our hands the means of realizing it."—General BRONSART VON SCHELLENDORF, former Minister of War.

"Decrepit States like the Argentine and Brazilian republics, and more or less all those beggarly States of South America, would be induced either by force or otherwise to listen to reason."—FRIEDRICH LANGE, in *Reines Deutschtum.*

"Should Belgium take part in the war, it must be struck off the map."—RUDOLPH THEUDEN, in *Was muss uns der Krieg bringen.*

"Germany, Austria-Hungary, and Italy, bound together by economic interests in Central Europe, form a great domain which would be very happily rounded off by the adhesion of Switzerland, Belgium, and Holland in the West and of Poland and Lithuania in the East."—PAUL DEHN, in *Deutschland unter der Orient.*

"It is sad to reflect that neither Paraguay nor Argentina belongs, even in part, to Germany today." — Professor JOHANNES UNOLD, of Munich.

"A MAGNIFICENT FIELD FOR GERMANY"

"The East is the only territory in the world which has not passed under the control of one of the ambitious nations of the globe. Yet it offers the most magnificent field for colonization; and if Germany does not allow this opportunity to escape her, if she seizes this domain before the Cossacks lay hands upon it, she will have secured the best share in the partition of the earth. The German Emperor would have the destinies of Nearer Asia in his power if some hundreds of thousands of armed colonists were cultivating these splendid plains; he might and would be the guardian of peace for all Asia."—A. SPRENGER, in *Babylonien*

Photograph by E. Niebergall

EVERY INCREASE IN THE FOOD SURPLUS OF AMERICA IS AN AID TO DEMOCRACY AND A BLOW AT AUTOCRATIC POWER

"Justice must and will become the supreme force in human affairs. No other result will insure civilization against the evil passions which today convulse the earth."

das reichste Land in der Vorzeit und das lohnendste Kolonisationsfeld fur die Gegenwart.

"All Morocco in the hands of Germany; German cannon on the routes to Egypt and India; German troops on the Algerian frontier—this would be a goal worthy of great sacrifices."—MAXIMILIAN HARDEN, in *Zukunft,* July 29, 1911.

"THE STORM FLAG OF THE EMPIRE"

"Now we know what the war is for. It is to hoist the storm flag of the empire on the narrow channel that opens and locks the road into the ocean. . . . We shall remain in the Belgian Netherlands, to which we shall add the thin strip of coast up to the rear of Calais. . . . From Calais to Antwerp, Flanders, Limburg, Brabant, to behind the lines of the French forts—Prussian. The southern triangle with Alsace-Lorraine and Luxemburg. We need land for our industries, a road into the ocean. . . . Never was there a war more just. It shall, it must, it will conquer new provinces for the majesty of the noble German spirit."—MAXIMILIAN HARDEN, in *Zukunft,* December, 1914.

"If Central Europe comes to nothing, then we shall indeed have Central Africa. Central Europe, on the other hand, without Central Africa cannot be contemplated for a moment."—Dr. PAUL LEUTWEIN (son of a former Governor of Southwest Africa), in *Europaische Staats-und Wirtschafts-Zeitung.*

"Germany's requirements come to this: it must stick to the position it has won at the southwest entrance of the North Sea (Antwerp) and must acquire the Suez Canal."—Vice-Admiral HERMANN KIRCHHOFF, in same journal.

"THE GIFT OF A VICTORIOUS WAR"

"We must think of a way, if we are to maintain ourselves as one among the world nations. This way has already been found in process of the war. It is called Association (Genossenschaft)—political, national, military, economic Association. The original nucleus of the Association is Central Europe (Germany plus Austria-Hungary); Poland, too, belongs to it by nature. The Near East is brought in to supply us both with (1) foodstuffs and (2) raw materials. A connecting bridge is also needed between Central Europe and the Near East. And there it is—Bulgaria."—PAUL ROHRBACH (of German Colonial Office), in *Deutsche Politik,* May 19, 1916.

"A victorious war . . . would give us the Belgian Congo, the French Congo, and, if Portugal continues to translate her hostile intentions toward us into actions, would also give us the Portuguese colonies on the east and west coasts of Africa. We should then have a colonial empire of which our fathers, who used to smile slyly at our first essays in colonization, could never have dreamt. But the most important factor in this probable partition of the African world is that we should have thereby put an end to the English attempts at dominion from the Cape to Cairo. Between Egypt, which is still English, and Anglo-Boer South Africa would stretch the immense band of our colonial possessions, extending from the Indian Ocean to the Atlantic. Still English, we say advisedly of northeast and South Africa; for who can tell what may happen when the words of the poet are realized: 'One day Germanism will be the salvation of the world.'"—*Kreuszeitung des Ostheeres* (official publication issued by German Commander at Lodz on the occasion of German Emperor's birthday, January 27, 1915).

A MATTER OF GERMAN "HONOR" TO HOLD ON TO BELGIUM

"In our opinion, it is radically necessary to improve our whole Western front from Belfort to the coast. Part of the North French Channel coast we must acquire if possible.

"On Belgium we must keep firm hold. . . . On no point are the masses more united, for without the slightest possible doubt they consider it a matter of honor to hold on to Belgium.

"Our friends, Austria-Hungary and Turkey, will open to us the Balkans and Asia Minor, and thus we shall assure ourselves of the Persian Gulf against the pretensions of Russia and Great Britain.

"We need liberty of the seas, which

Photograph by Leet Brothers

PRESIDENT WILSON MARCHING AT THE HEAD OF THE PARADE HELD WHEN THE FIRST SELECTIVES IN THE WAR AGAINST GERMAN AUTOCRACY WERE CALLED TO THE COLORS

Up Pennsylvania Avenue the Commander-in-Chief of the Army and Navy of the United States of America led the first men to be called from civilian life to take up arms in behalf of their own land and of all free peoples against Prussianism

was the real cause of war between England and Germany. To obtain it we must have Egypt."—From the Manifesto of German Professors, October, 1914.

"POSSESSION OF NORTHERN FRANCE IS VITAL"

"So far as regards France, the possession of the coastal districts bordering on Belgium as far as the neighborhood of the Somme must be regarded as a vital matter for our future position at sea. The 'hinterland,' which must be acquired with them, must be so delimited that the complete use of the canal ports which we gain, both for industrial and strategic purposes, must be secured. All further acquisitions of French territory, apart from the necessary annexation of the mining district of Briey, must be determined purely according to military and strategical considerations. After the experiences of this war, it must be regarded as a matter of course that we must not in the future leave our frontiers open to hostile invasion, as we should do if we left to our opponents those fortified positions which threaten us, and in particular Verdun and Belfort and the part of the western slopes of the Vosges which lies between them. With the acquisition of the line of the Meuse and the French coast to which the canals lead and the mining districts of Briey, which have been mentioned, the possession of the canal districts in the Department of the Nord and the Pas de Calais is necessarily included.

"The necessity of strengthening the agricultural basis of our nation requires a considerable extension of the Imperial and Prussian frontiers in the East by annexation of at least parts of the Baltic provinces and of those territories which lie to the south of it.

"The reconstruction of East Prussia requires the better security of its frontiers by placing in front of them considerable districts, and also West Prussia, Posen, and Silesia must not remain frontier marches exposed to danger as they are now.

"The security of the German Empire imperatively requires the possession of the whole adjoining territory of Luxemburg and Lorraine, including the fortifications of Longwy."—From the Manifesto of Six Industrial Associations, May, 1915.

CONQUEST OF INDIA AND CHINA WITH TURKEY'S AID

"With the help of Turkey, India and China may be conquered. Having conquered these, Germany should civilize and Germanize the world, and the German language would become the world language."—THEODOR SPRINGMAN, *Deutschland und der Orient,* 1915.

"In a hundred years the American people will be conquered by the victorious German spirit, so that it will present an enormous German Empire. Whoever does not believe this lacks confidence in the strength of the German spirit."—ROBERT THIEM, *Alldeutsche Blatter,* 1902.

"At the present moment the center of German intellectual activity is in Germany; in the remote future it will be in America. . . . Germans only need to grasp the situation and the future is theirs. Let them show that they mean to maintain Deutschtum, and then emigration may be directed to America with impunity."—HUBBE-SCHLEIDEN, in *Alldeutsche Blatter,* 1903.

"Not only North America, but the whole of America must become a bulwark of Germanic Kultur, perhaps the strongest fortress of the Germanic races. That is every one's hope who has freed himself from his own local European pride and who places the race feeling above his love for home. Also South America must and can easily become a habitation for German or Germanoid races!"—KLAUS WAGNER, *Krieg,* 1906.

James W. Gerard, former United States Ambassador to Germany, in his account of his experiences at the Imperial Court, declares: "An official (German) declared (in 1915) that they had tried to get England to interfere, together with them, in Mexico, and Germans 'Gott strafe' the Monroe Doctrine in their daily prayers of hate. Every night fifty million Germans cry themselves to sleep because all Mexico has not risen against us."

ACES AMONG ACES

By Laurence La Tourette Driggs

AIR duels were unknown four years ago. Boys of 18 or 20, untaught and inexperienced in the art, have flown aloft and mastered it—mastered it so thoroughly that less prudent antagonists have fallen before them, sometimes six in one day. At least a score of such duels have been reported where the victor won by the expenditure of a single bullet!

Lufbery for America, Guynemer for France, Bishop for Great Britain, and von Richthofen for Germany have towered above their comrades from the popular viewpoint because of their conspicuous successes in this new art of aëroplane dueling.

To promote this new and spectacular branch of warfare, the rival air forces of the belligerents have constructed the swiftest and deadliest types of aëroplanes, to be manned by their air duelists—expert sharpshooters and pilots—whose duty it is both to attack the heavy bombing and reconnaissance planes of the enemy and to defend their own slower aëroplanes from chasing aviators.

Each belligerent nation has collected the cream of its sharpshooters into one squadron, or escadrille, where as one unit they can be hurled into a threatened area with every prospect of success over less skilled antagonists.

THE PREMIER ESCADRILLE

France has her Cigognes ("Storks"), the celebrated Spad 3, to which belong Fonck, Heurteaux, Pinsard, Deullin, Gond, Herrison, the Americans Baylies and Parsons, and those who have made the sacrifice supreme—Guynemer, Auger, René Dorme, and de la Tour.

America has her Escadrille Lafayette, which was commanded by Major Lufbery and which stands third among all the fighting escadrilles of France in the number of enemy aëroplanes shot down.

The British have R. F. C. Squadron No. 1, which is commanded by Captain Fullard and which brought down 200 German aëroplanes in a short six months.

And the Germans entrusted their hopes to the famous Tango Circus, so nicknamed by the English pilots by reason of the close formation in which the gaudily painted aëroplanes of this enemy unit flew. The victories claimed by this band amount to more than double those accorded to any single squadron of the Allies. And the commander of this Jagdstaffel No. 11 holds the world record in air dueling, for he lived to conquer 80 enemy machines.

FONCK, OF THE CIGOGNES

The most polished aërial duelist the world has ever seen is René Fonck, aged 23, now flying with the Cigognes, Spad 3. This is the famous fighting escadrille that was commanded by Guynemer at the time of his disappearance, September 11, 1917. Curiously enough, Lieutenant Fonck, who was then a member of Escadrille N. (Nieuport) 103, was Guynemer's avenger. He shot down on September 21 the German pilot, Lieutenant Wissemann, who had written home to his mother in Cologne, boasting that he had been victorious over Guynemer and now need fear no one. As no proof of Guynemer's death has yet been found, the truth of Wissemann's claim is doubted.

Consider the details of Fonck's record. Up to April 3, 1918, he had shot down officially 32 enemy aircraft, engaged in upward of 200 combats, flown over 1,000 hours above the enemy's lines, yet *had never received a bullet hole in his aëroplane!* Now he has 45 enemy planes on his tablet and is the French ace of aces.

Most of his combats are against formations of five or more enemies. While delivering the *coup de grace* to one he must prevent a surprise from the others. How he succeeds in this could never be satisfactorily explained, yet that he does succeed is beyond question. Such incredible perfection in maneuvering and such rapid and infallible accuracy of aim have never been equalled by any other fighting pilot.

LIEUTENANT RENÉ FONCK ON THE MACHINE WITH WHICH HE DESTROYED SIX GERMAN PLANES IN ONE DAY

Lieutenant Fonck, of the Cigognes, the most famous of French escadrilles, is the world's most polished aërial duelist. He had shot down 32 enemy aviators, had flown more than 1,000 hours above the enemy lines, and had taken part in 200 combats before receiving a single bullet-hole in his own machine. It was Fonck who shot down Wissemann, the German aviator who is reputed to have killed Guynemer.

Lieutenant Dorme, of the same escadrille, who had 23 on his score at the time of his mysterious disappearance May 25, 1917, had shot down 10 of this number before he received more than two bullets in his own machine. He was nicknamed "the Unpuncturable" by his comrades for this superb skill and good luck. Guynemer returned daily with his plane, and even his clothing, riddled with bullet holes. One can but wonder at the miraculous record made by Fonck.

FONCK REVEALS HIS SECRET

But is it a miracle? Let Fonck himself tell the secret. In an interview with

Photograph by Press Illustrating Service

THE AMERICAN ACE, MAJOR RAOUL LUFBERY, AND HIS NIEUPORT

Note the gun on the engine hood, synchronized to fire through the propeller. On the machine at the rear a Lewis gun is shown mounted on the top plane. Major Lufbery was killed in an air fight on May 19, 1918. His record of official victories over the Huns was 18.

La Guerre Aerienne, of Paris, recently he made the following observations concerning his preparations for combat:

"One must be in constant training, always fit, always sure of oneself, always in perfect health. Muscles must be in good condition, nerves in perfect equilibrium, all the organs exercising naturally.

"Alcohol becomes an enemy—even wine. All abuses must be avoided. It is indispensable that one goes to a combat without fatigue, without any disquietude, either physical or moral.

"It must be remembered that combats often take place at altitudes of twenty to twenty-five thousand feet. High altitudes are trying on one's organisms. This indeed is, at bottom, the reason that keeps me from flying too continuously. And I never fly except when in perfect condition. I am careful to abstain when I am not exactly fit. Constantly I watch myself.

"It is necessary to train as severely for air combats as for any other athletic contest, so difficult is the prize of victory. Yet if one finds oneself in prime condition, all the rest is play."

And these precepts come not from a Sunday-school teacher, but from a youth who has demonstrated his theory with as thorough a test as can be imagined.

"All the rest" may be play, yet there is in that little play of Fonck's a secret of quickness and anticipation that is almost superhuman.

HOW HE DESTROYED SIX MACHINES IN ONE DAY

Lieutenant Fonck is the only Frenchman who has brought down six enemy aircraft in one day. He went up back of Soissons with his patrol on May 9 last and encountered three two-seater machines of the enemy. Two of these he destroyed in less than ten seconds and

Photograph from Paul Thompson

AMONG LIVING AVIATORS HE HOLDS THE WORLD'S RECORD FOR VICTORIES

Major William A. Bishop, V. C., D. S. O., M. C., premier ace of Great Britain's Royal Flying Corps, is a Canadian, 23 years of age. Seventy-two Hun planes have fallen before the skill of this master airman. Major Bishop came to America on furlough last winter and while in Washington, D. C., visited the headquarters of the National Geographic Society, where he wrote "Tales of the British Air Service," published in the January, 1918, number of the NATIONAL GEOGRAPHIC MAGAZINE.

the third fell five minutes later. That afternoon he ran onto a formidable formation of five of the new Pfalz fighting machines working in contact with five Albatros scouts—all single-seaters. He dived into them and sent down three, one after another, the remainder breaking up and escaping before he could catch them. These six machines were shot down with an expenditure of ten cartridges per machine!

THE STORY OF RAOUL LUFBERY

Raoul Lufbery, the boy who ran away from his home in Wallingford, Conn., when he was 17, who wandered half the world over, working at odd jobs until his curiosity was satisfied and his purse replenished, who enlisted as a regular soldier in 1907, and went to the Philippines for two years, where he won all the prizes of his regiment as the best marksman on the range, and who entered aviation in France, his mother's country, mainly to avenge the death of his friend and patron, Marc Pourpe—this same Major Raoul Lufbery met his death on Sunday morning, May 19 last, with a record of 18 German aëroplanes shot down, which is the highest score held by any American. Not a newspaper in our land but told of his loss. This runaway boy died leaving his name as well known to his countrymen as is that of Pershing or Sims.

Among the last heroic survivors of the old school of war-fliers, Lufbery was revered and is mourned most keenly by the group of our young airmen who were under his tutelage in the Escadrille Lafayette, the Spad 124. One of these,

Courtesy of Capt. Jean Richard

ACES AMONG ACES: SOME OF THE MOST FAMOUS AIRMEN WHO HAVE FLOWN FOR FRANCE AND HUMANITY

From right to left: Capt. Albert Heurteaux, Capt. Alfred Auger, Commander Hogrel, Capt. Georges Guynemer, Lieut. Albert Deullin, Lieutenant Andre, Lieut. René Dorme, and Lieutenant Raymond.

David E. Putnam, has already surpassed his chief in one day's chase, having brought down five enemy machines on June 10, according to a dispatch from France.

This places Sergeant Putnam in the proud position of America's ace of aces, with a total score of 13 aëroplanes shot down. Forty-two other young American pilots have won one or more victories over their opponents. Ten of them have won their fifth and with it the title of ace.

THE HIGH-SCORE ACE OF THE ROYAL FLYING CORPS

"The King has been graciously pleased to approve the award of the Victoria Cross to Second Lieutenant (temporary Captain) James Byford McCudden, who already possesses the Distinguished Service Order, the Military Cross, the Military Medal, the General List, and Royal Flying Corps, for most conspicuous bravery, exceptional perseverence, keenness, and very high devotion to duty."

So reads a communique of recent date from the British War Office. Captain McCudden has brought down 54 enemy aëroplanes, which gives him the highest score among the British pilots, Philip F. Fullard coming next, with 48, and William A. Bishop, the Canadian, who visited the United States during last winter, standing third, with 47 victories.

(Since the above was written an unofficial report states that Major Bishop has added 25 more victories to his score of 47, making a total of 72; stating further that he has retired from air fighting to instruct his freshmen pilots in the art of air dueling. Bishop has now but one competitor for the world's record in the number of aircraft destroyed—Captain von Richthofen.)

FRENCH HEROES WHO ARE AT HOME IN THREE ELEMENTS—EARTH, AIR, AND WATER

After a plunge in the Somme, three French airmen and their squad physician brave the camera. The tall officer, with the cap and cane, is Lieutenant Benois, now in America attached to the French military mission. The officer on the extreme right is Capt. Jean Richard, formerly of the Storks Escadrille, but now detailed to artillery and stationed in Washington temporarily. Lieutenant Raymond stands next to the physician, who wears the black bathing suit.

Capt. Albert Ball, the conqueror of Germany's star air fighter, Immelmann, was himself killed in combat with Lieut. von Richthofen a year ago, after having amassed 43 official successes, at that time the world's record.

Not only does the British champion, McCudden, surpass all his countrymen at the front since Bishop's retirement, but he leads the highest score in France, that of Georges Guynemer, who went out for the last time on September 11, 1917, having at that time accounted for 53 German aëroplanes.

WHAT CONSTITUTES CONSPICUOUS BRAVERY

Let us see what constitutes "conspicuous bravery," in the opinion of the unemotional custodians of the Victoria Crosses in England.

On two occasions McCudden has totally destroyed four two-seater machines on the same day; on the last occasion all four of such two-seaters were destroyed within one hour and 30 minutes—costing Germany some $250,000, as the value of aëroplanes and trained pilots is computed, for this hour and a half of young McCudden's time.

On December 23, 1917, when leading his patrol, he attacked eight hostile aëroplanes. Two of them he shot down, the others he drove deep into their own lines, returning home himself only when his Lewis gun ammunition was exhausted and the belt of his Vickers gun had broken.

The citation says: "As a patrol leader he has at all times shown the utmost gallantry and skill not only in the manner in which he has attacked and destroyed the enemy, but in the way he has during

several fights *protected the newer members of his flight,* thus keeping their casualties down to a minimum. (The italics are my own.) This officer is considered by the record which he has made, by his fearlessness, and by the great services which he has rendered to his country, deserving of the very highest honor."

It requires bravery truly to bring down 54 armed aëroplanes. But that bravery becomes conspicuous and deserving of the very highest honor when it includes shielding from danger the little fellows who are devotedly following their daring leader.

THE CAREER OF CAPTAIN VON RICHTHOFEN

Manfred von Richthofen, favorite of the Kaiser, a brilliant fighter, a chivalrous gentleman, and the pride of the German army, was the celebrated commander of the enemy air squadron officially known as Judgstaffel No. 11, but familiar to all airmen as the Tango Circus. Of aristocratic birth, he was a lieutenant of Uhlans before the outbreak of the war. The former air champion, Captain Boelke, induced him to enter the Air Service in 1915, and his first victory was won in September, 1916. In seven months the flying squadron which he led shot down 200 aëroplane antagonists.

In less than fifteen months active flying, von Richthofen personally brought down 70 aëroplanes and 10 observation balloons, mostly British. He flew the swiftest type of aëroplanes that German constructors could build, and he mounted upon them two Spandau machine-guns that fired straight ahead between the blades of the propeller. His machine he painted a bright red, and for the past eight months his menacing presence thus courted identification from his enemies with a self-confidence and audacity truly admirable.

He was shot down April 21, 1918, over the Somme River, at the Amiens front, and his new Fokker triplane, a personal gift to him from Fokker himself, fell into the British lines. This machine flew 140 miles per hour and climbed 15,000 feet in 17 minutes. Orders found in his pockets indicated that the enemy army commanders desired this sector cleared of British aëroplanes on the morning of April 21 at all costs. But it is doubtful whether the fall of Amiens itself would have compensated Germany for the cost she paid in the loss of this great ace.

GENEROUS TRIBUTE TO THE ENEMY ACE

The following generous tribute to an enemy airman is written by C. G. Grey, of London:

"The greatest of our enemies in the air, Rittmeister Freiherr Manfred von Richthofen, is dead. The Royal Flying Corps, his particular foes, will hear the news with mixed feelings. They will rejoice that he is out of action, but will regret sincerely the death of a gallant gentleman who fell bravely doing his duty.

"Only a few days ago one of the best of our airmen expressed the hope that he and von Richthofen might survive the war, so that they might compare notes. Some few months ago a dinner was given to another of our renowned fighting pilots by his squadron, in honor of his winning the Distinguished Service Order. In returning thanks, the hero of the evening, as gallant a lad as ever flew, stood up and proposed the health of von Richthofen. And the fighting pilots of the squadron arose and duly honored an enemy whom they respected. Both the proposer of the toast and his enemy are now dead. One hopes that beyond the shadows they have met, as gallant enemies do when they have fought a good fight and peace has come to them.

"These two incidents indicate, one believes, the feelings of the Royal Flying Corps toward Rittmeister von Richthofen. There is not one in the corps who would not gladly have killed him. But there is not one who would not equally gladly have shaken hands with him had he been brought down without being killed or who would not so have shaken hands if brought down by him.

"His death is bound to have a depressing effect upon the German Flying Service, for obviously the younger and less brave pilots will argue that if a von Richthofen cannot survive their chances must be small. Equally, his death is an encouragement to the younger Allied pilots who can no longer imagine that every skillful German who attacks them is von Richthofen himself.

"However, Manfred von Richthofen is dead. He was a brave man and a clean fighter. May he rest in peace."

Who can now say the day of chivalry is past? Our great enemy ace was buried with full military honors, in French soil, on April 22, and his personal effects were sent home to his family.

A MEAN AND BITTER EPILOGUE

It would be pleasanter to leave the story of von Richthofen's gallant death and funeral thus; but an interesting, though contemptible, epilogue is thrust upon our attention from the land of the fallen hero. It is penned by the notorious Count Reventlow, and appears in the May 1 issue of the *Deutsche Tagezeitung* to poison the mind of the Boche and inflame it into greater hatred against the foe. It says:

"These honors are nothing but the manifestation of British self-advertisement of their 'chivalry.' We once heard much of the chivalrous treatment accorded by the English to Captain von Muller, of the *Emden,* but as soon as he was able to speak we found that instead of chivalrous treatment he had received nothing but deliberate vileness, contempt, and torture from his captors.

"For our part we cannot consider the honors given to the remains of von Richthofen as sincere. The English press is full of them, and with characteristic blatancy blares about British magnanimity. But they say nothing about the huge prizes in money that were offered to the pilot who could kill Richthofen. In fact, these must have amounted to an enormous sum. And this explains the bitter and 'noble' controversy which raged around the corpse of the fallen pilot, for there was cash waiting for the one who inflicted the fatal wound and brought the German machine to earth. The officials themselves who buried our hero were all fortunate money-makers. Thus this spectacle takes on a thoroughly disgusting aspect."

To which Marc Antony might well have said: "Oh Judgment! Thou hast fled to brutish beasts, and men have lost their reason!"

In truth, the official reports have indicated that it is in doubt as to whether von Richthofen fell from a shot from the air or from the ground. Many aëroplanes were engaged in a "dog fight" at very low levels at the time and machine-guns from the British lines took part in the fray. Suddenly Richthofen's gaudily painted triplane darted into the ground and smashed. Investigation disclosed a bullet through his heart, but from whence it came could not be ascertained.

Subsequently the *Toronto Globe* announced that von Richthofen's conqueror was Capt. Roy Brown, of Carleton Place, Ontario, who was one of the fighting pilots participating in the combat.

THE ROLL OF ACES OF ALL BELLIGERENTS

Having described their methods and peculiarities and studied their characteristics, which account for their proved superiority both over their enemies and in comparison with their comrades, let us look at the complete score of the aces of aviation of all the belligerent countries.

This score I have been tabulating since the war in the air began, and it is officially correct up to the date of June 15, 1918, with the exception of the list of British aces, whose records are not made public until His Majesty is graciously pleased to confer upon them the Victoria Cross or the Distinguished Service Order for some extraordinary and brilliant performance of duty. Many British aces must, therefore, be omitted from the following table.

THE SCORE OF THE LIVING ACES OF FRANCE

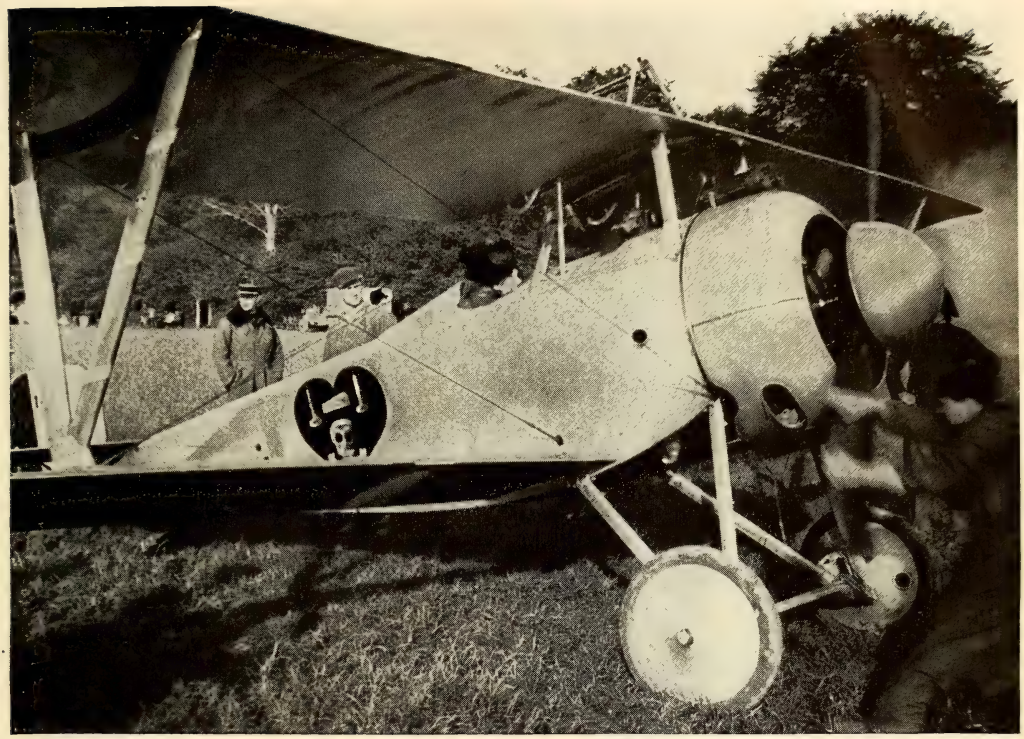
Fifty-five French aces, living, have brought down 547 enemy aëroplanes, as follows:

Lieut. René Fonck	45
Lieut. Charles Nungesser	36
Lieut. George Madon	34
Capt. Albert Heurteaux	21
Adjt. Guerin	21
Lieut. Deullin	19
Capt. Armand Pinsard	18
Lieut. Maurice Boyau	18
Lieut. de Meuldre	13
Lieut. Marcel Hughes	12
Adjt. Jailler	12
Lieut. Sardier	11
Lieut. Tarascon	11
Lieut. Ortoli	11
Adjt. Andre Herbelin	10
Lieut. Garaud	10
Lieut. de Turrenne	10
Adjt. Chainat	9
Adjt. Casale	9
Adjt. Dauchy	9
Lieut. Viallet	8
Capt. Derode	7
Lieut. de Sevin	7

Courtesy of Capt. Jean Richard

LEFT TO RIGHT: CAPT. LORD HAMILTON, CAPT. HEURTEAUX, CAPT. GUYNEMER, H. R. H. THE PRINCE OF WALES (WHO IS AN HONORARY MEMBER OF THE STORKS ESCADRILLE), LIEUTENANT CASSAR (STAFF OF PRINCE OF WALES), CAPT. DE LA TOUR, AND CAPTAIN D'HARCOURT

Lieut. de Slade	7	Soldat Louis Martin	6
Adjt. Leon Vitalis	7	Lieut. Leps	6
Lieut. Lachmann	7	Lieut. Raymond	6
Lieut. Flachaire	7	Lieut. Alex Borzecky	5
Adjt. Victor Sayaret	7	Adjt. Bloch	5
Lieut. Jean L'hoste	7	Lieut. Paul Gastin	5
Sergt. René Montrion	7	Lieut. Regnier	5
Sergt. du Bois d'Aische	6	Comdr. de Marancourt	5
Lieut. Covin	6	Adjt. Herrison	5
Lieut. Bonnefoy	6	Lieut. Marty	5
Sergt. Soulier	6	Adjt. Blanc	5
Lieut. Gond	6	Sergt. Quette (missing May 16, 1918)	5
Sergt. Boyau	6	Sergt. Bouyer	5
Adjt. Dhôme	6	Adjt. Casenove de Pradines	5
Adjt. Peronneau	6	Sergt. Pierre Marinovitch	5
Sergt. Rosseau	6	Lieut. Nogues	5



Photograph from Laurence La Tourette Driggs

LIEUTENANT CHARLES NUNGESSER; SCORE, 36 HUNS

Nungesser is second only to Lieutenant Fonck among living French fliers in the number of his victories. His fighting plane mounts one gun on the engine hood and one on the upper plane.

RECORD OF FRANCE'S HERO DEAD

Nineteen French aces, dead or retired, have brought down 208 enemy aëroplanes.

(The date of the termination of the ace's activities is indicated in parentheses.)

Capt. Georges Guynemer (September 11, 1917)	53
Lieut. René Dorme (May 15, 1917)	23
Lieut. Jean Chaput (May 18, 1918)	16
Lieut. Navarre (retired April 10, 1917)	12
Lieut. de la Tour (December 21, 1917)	11
Adjt. Maxime Lenoire (October 25, 1916)	11
Capt. Georges Matton (September 10, 1916)	9
Sergt. Sauvage	8
Capt. René Doumer (April 26, 1917)	7
Lieut. de Rochefort	7
Capt. Alfred Auger (July 28, 1917)	7
Lieut. Henri Languedoc	7
Lieut. de Mortemart (March 20, 1918)	6
Lieut. Adolph Pegoud (August 31, 1915)	6
Lieut. Andre Delorme	5
Sergt. Marcel Hauss	5
Capt. Lecour-Grandmaison (May 10, 1917)	5
Lieut. George Baillot (May 20, 1916)	5
Adjt. Pierre Violet (December 27, 1916)	5

The total of 74 French aces, living and dead, is 755 enemy aëroplanes shot down to June 15, 1918.

WHAT UNITED STATES ACES HAVE DONE

Maj. Raoul Lufbery (killed May 19, 1918)	18
Sergt. David E. Putnam, Brookline, Mass.	13
Lieut. Frank L. Baylies, New Bedford, Mass. (missing June 20, 1918)	12
Maj. William Thaw, Pittsburgh, Pa.	5
Lieut. Robert Magoun, Boston, Mass. (wounded April 8, 1918)	5
Lieut. Douglass Campbell, Pasadena, Cal.	5
Adjt. Edwin C. Parsons, Springfield, Mass.	5
Lieut. H. Clay Ferguson (wounded March 12, 1918)	5
Lieut. Paul Frank Baer, Mobile, Ala. (missing May 22, 1918)	5
Corp. David McK. Peterson, Honesdale, Pa. (last victory unofficial)	5
Lieut. Edward Richenbacker, New York	5

Eleven American aces have a total of 83 enemy planes brought down. Several of the British aces are Americans who enlisted in the Royal Flying Corps.

THE BRITISH LIST

Major William A. Bishop	72
Capt. James McCudden	54
Capt. Philip F. Fullard	48
Capt. Henry W. Wollett (13 in one day)	28
Lieut. John J. Malone	20
Lieut. Allan Wilkenson	19
Lieut. Stanley Rosevear	18
Lieut. Robert A. Little	17

Lieut. Clive Warman	15
Lieut. Fred Libby	14
Capt. W. C. Campbell	14
Lieut. R. T. C. Hoidge	14
Capt. Murray Galbraith	13
Lieut. Joseph Stewart Fall	13
Lieut. A. K. Cowper	12
Capt. Whitaker	12
Capt. Robert Dodds	11
Lieut. M. D. G. Scott	11
Lieut. Raymond Collinshaw	10
Lieut. R. A. Mayberry	9
Lieut. John Andrews	9
Capt. Gilbert Ware Green	9
Lieut. K. R. Park	9
Lieut. M. B. Frew	8
Sergt. Dean I. Lamb	8
Lieut. Boyd Samuel Breadner	8
Lieut. Andrew McKeever	8
Lieut. J. H. T. Letts	8
Lieut. Lionel B. Jones	7
Lieut. A. S. Shepherd	7
Lieut. James Dennis Payne	7
Lieut. G. E. H. McElroy	7
Capt. C. A. Brewster-Joske	7
Capt. Wagour	7
Capt. Frank G. Quigley (all in one day)	6
Capt. G. E. Thomson	6
Capt. Lancelot L. Richardson	6
Lieut. Cecil Roy Richards	6
Lieut. Howard Saint	6
Lieut. Fred John Gibbs	6
Lieut. C. W. Cuddemore	6
Lieut. William Lewis Wells	5
Lieut. E. D. Clarke	5
Capt. Fred Hope Lawrence	5
Lieut. Edward R. Grange	5
Lieut. W. G. Miggitt	5
Lieut. Lawrence W. Allen	5
Lieut. William D. Matheson	5
Lieut. Stanley J. Coble	5
Capt. G. H. Boarman	5
Lieut. F. T. S. Menendez	5
Capt. K. C. Patrick	5
Sergt. T. F. Stephenson	5
Comdr. F. C. Armstrong	Many
Comdr. R. F. Minifie	"
Comdr. E. L. N. Clarke	"
Comdr. R. B. Munday	"
Comdr. G. W. Price	"
Comdr. R. J. O. Compston	"
Lieut. V. R. Stokes	"
Lieut. W. C. Canbray	"
Lieut. H. T. Beamish	"
Lieut. E. T. Hayne	"
Lieut. G. W. Hemming	"
Lieut. J. E. L. Hunter	"
Lieut. W. A. Curtiss	"
Capt. H. T. Mellings (wounded May 18, 1918)	"
Lieut. Gerard B. Crole	"
Lieut. Robert N. Hall	"
Lieut. David Sidney Hall	"
Lieut. M. J. G. Day	"
Lieut. E. G. Johnston	"
Lieut. W. L. Jordan	"
Lieut. M. H. Findley	"
Lieut. C. B. Ridley	"

BRITISH DEAD OR RETIRED

Capt. Albert Ball	43
Capt. Brunwin Hales	27
Capt. Francis McCubbon	23
Capt. George Thomson	21
Capt. J. L. Trollope (six in one day)	18
Lieut. Leonard M. Barlow	17
Lieut. Clive F. Collett	15
Capt. H. G. Reeves	13
Capt. Noel W. W. Webb	12
Lieut. Rhys-David	9
Capt. Henry G. Luchford	7

Estimating "many" as at least five, the known list of the British aces accounts for at least 950 enemy aëroplanes with the above named 86 members. Undoubtedly the complete list will disclose another score of British aces.

RECORD OF ITALIAN ACES

Maj. Baracca (killed June 21, 1918)	36
Lieut. Barachini	31
Lieut. Ancilotti	19
Col. Piccio	17
Capt. Duke Calabria	16
Lieut. Scaroni	13
Lieut. Olivari (killed)	12
Lieut. Hanza	11
Sergt. Maisero	8
Lieut. Parnis	7
Sergt. Poli	6
Lieut. Luigi Olivi	6
Lieut. Stophanni	6
Lieut. Arrigoni	5

Fourteen Italian aces have totalled 193 victories.

EIGHT BELGIAN ACES, 60 VICTORIES

Adjt. Coppens	13
Lieut. Thieffry (killed February 23, 1918)	10
Lieut. de Meulemeester	10
Lieut. Jan Olieslagers	6
Adjt. Beulemest	6
Capt. Jaquette	5
Lieut. Robin	5
Adjt. Medaets	5

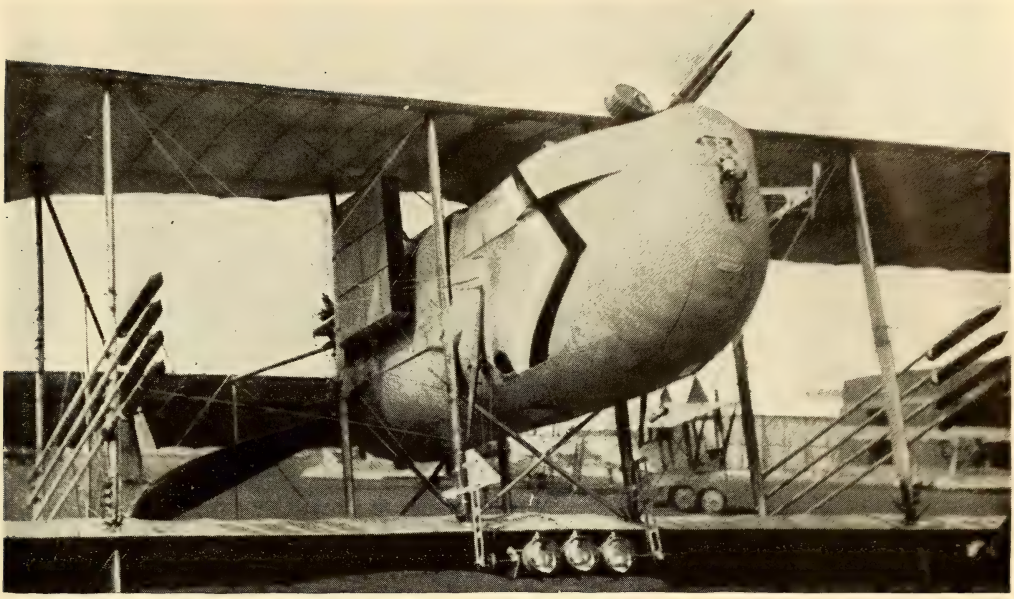
RUSSIAN ACES

Capt. Kosakoff	17
Capt. Kroutenn (killed June 22, 1917)	6
Lieut. Pachtchenko	5

LIVING HUN ACES TOTAL 747 PLANES

Thirty-six German and four Austrian aces, living, total 747 aëroplanes.

Lieut. Max Buckler	33
Capt. Berthold	33
Lieut. Menckhof	33
Lieut. Loerzer (wounded June 15, 1918)	33
Lieut. Schleich	30
Capt. Brunowsky, Austria	29
Lieut. von Bulow	28
Lieut. Kroll	28
Lieut. Wuesthoff	27
Lieut. Udet	27
Lieut. Lowenhardt	27
Lieut. Arigi, Austria	26
Lieut. Peutter	25
Lieut. Link Crawford, Austria	23
Capt. Baumer	23
Lieut. Kirstein	23
Corp. Rumey	23
Lieut. Klein	22
Lieut. Windisch	21
Lieut. Adam	21
Lieut. Veltgens	21
Lieut. Thuy	20
Lieut. Reinhardt	20
Lieut. Kissenberth	17
Lieut. Schmidt	15
Lieut. Hess	13
Lieut. Muller	13
Lieut. Goettsch	13
Lieut. Goering	10
Lieut. Banfield, Austria	9
Sergt. Frickart	9
Lieut. von Althaus	8
Lieut. Esswein	6
Lieut. Walz	6
Lieut. Hehn	6
Lieut. Koenig	6
Capt. Zauder	5
Lieut. Brauneck	5
Lieut. Ullmer	5
Lieut. Roth	5



Photograph by International Film Service

A TYPE OF NIGHT-FLYING AIRPLANE NOW IN USE

Note the four rockets on each side and the machine-gun protruding over the bow of the boat-shaped fuselage. The radiators for the motor are on each side of the fuselage. Below the lower plane of the machine is a battery of three searchlights controlled, of course, by wired levers within reach of the pilot. A touch of humor is supplied in the manikin figure-head at the bow.

Forty-eight German aces, dead or retired, have brought down 923 aëroplanes.

(Date when activities ceased is indicated in parentheses.)

Capt. von Richthofen (killed April 21, 1918)	80
Lieut. Werner-Voss-Crefeld (killed Oct. 8, 1917)	49
Capt. Boelke	40
Lieut. Gontermann (November 3, 1917)	39
Lieut. Max Muller (January 15, 1918)	38
Lieut. Bongartz (wounded March 3, 1918)	36
Lieut. Cort Wolf	33
Lieut. Schaeffer	30
Lieut. Almenroeder	30
Lieut. von Richthofen, wounded	29
Capt. von Tutscheck (March 17, 1918)	27
Lieut. Barnet (October 13, 1917)	27
Lieut. Dosler (January 1, 1918)	26
Lieut. Erwin Boehm (December 1, 1917)	24
Lieut. von Tschwibon (November 22, 1917)	20
Lieut. von Eschwege	20
Lieut. Bethge (March 17, 1918)	20
Capt. Behr	19
Lieut. Thulzer	19
Lieut. Baldamus	18
Lieut. Wintgens	18
Lieut. Frankel	17
Leigel (May 13, 1918)	15
Lieut. Schneider	15
Lieut. Immelmann	15
Lieut. Nathanall	14
Lieut. Dassenbach	14
Lieut Festner	12
Lieut. Pfeiffer	12
Lieut. Manschatt	12
Lieut. Hohndorf (October 13, 1917)	12
Lieut. Mutschaat	12
Lieut. Buddecke	12
Lieut. von Kendall	11
Lieut. Kirmaier	11
Lieut. Theiller	11
Lieut. Herman Serfert	11
Lieut. Mulzer	10
Lieut. Leffers	9
Lieut. Schulte	9
Lieut. Parschau	8
Lieut. Schilling	8
Lieut. Immelmann	6
Lieut. Fahlbusch	5
Lieut. von Siedlitz	5
Lieut. Rosenkranz	5
Lieut. Habor	5
Lieut. Reimann	5

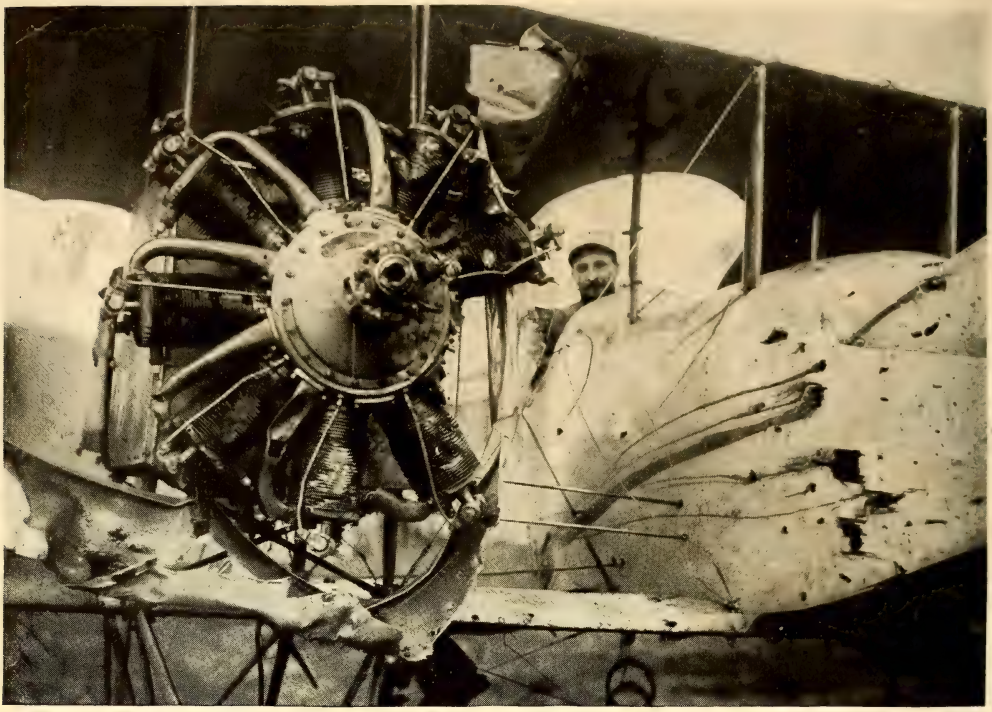
Thus, 88 German aces have shot down 1,670 aëroplanes of the Allies. On July 26, 1917, Germany claimed a total of 2,387 enemy aircraft destroyed since the beginning of the war. Since that time more than 1,000 have been added to this list.

TURKISH ACE

Capt. Schetz ..... 8 successes

ALLIES' LIVING ACES, 157; HUNS, 40

Summarizing the foregoing table of the aces and their victories, we find that 88 Germans have brought down 1,670 hostile aircraft since the beginning of the war, while 193 Allied aces have considerably exceeded this score, with 2,041 enemy aircraft shot down. The startling feature in this comparison is the dis-



Photograph from Laurence La Tourette Driggs

AËROPLANE STRUCK IN MID-AIR BY A SHELL WHICH CARRIED AWAY ONE CYLINDER OF THE ROTARY MOTOR WITHOUT DESTROYING THE MACHINE

closure that German tactics in the air have permitted our enemy to destroy four-fifths as many aëroplanes with one-half the number of aces.

Cowardly as those tactics are, unsportsmanlike as the enemy pilots must admit themselves to be, the German method of air fighting has proved its superiority over the more daring and generous tactics of the Allies, both in economy in the use of man power and machines and in efficiency.

But another conclusion can also be drawn from these figures. Our enemy has but 40 pilots of the ace class remaining, while the Allies have 157. The dead or retired in the enemy list number 48, with 923 victories, as against the 40 still fighting, with 747 victories.

So, not only have our aërial duelists put *hors de combat* the majority of the enemy's star fighters, but in accomplishing this feat we have increased rather than lessened our own supply of expert duelists.

Add to this indication of ultimate supremacy the fact that the allied nations are now producing three or four times as many aëroplanes as Germany, and that the flying schools of the United States are crowded with eager lads impatiently waiting for their fighting mounts, and we begin to feel that the dueling days of Germany's 40 aces will soon be over.

THE TASK OF THE ALLIED ACES

And this 40 must be swept from the skies before our machines of reconnaissance and photographing can operate to perfection. Until the fighting planes of the enemy are suppressed our bombing machines are constantly menaced in their raids over enemy lines. One week's freedom from this menace would permit our bombing squadrons so to destroy the enemy's railroads and highways that the German forces at the front would be wholly deprived of food, ammunition, supplies, and reinforcements. Either retirement or surrender must ensue.

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